AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

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For Sale Everywhere by Newsdealers.

ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

The Elliott Stitcher and Knot-Tying Machine.

The accompanying engraving represents a thread-stitching and knot-tying machine, designed and invented by Sterling Elliott, of Newton, Mass., which we believe to be one of the most remarkable and ingenious machines of the kind yet brought out. In this machine the inventor has accomplished, in a simple and practical manner, what has heretofore been considered impracticable, viz., the tying of a square knot by machinery. Such machines have heretofore been classed with perpetual-motion machines, and similar impossibilities.

The desirability of such a machine is at once apparent to all bookbinders and stationers, and others of that class of trade, as evidenced by the success of the wire-stitching machines, which mode of holding a number of sheets together has been adopted in a majority of cases, because, when stitched with thread by hand, the girls will not tie a knot that cannot be drawn out by a slight pull. With this machine, this objection is overcome, and added to the great speed obtained, puts a thread-stitched pamphlet, with a hard, square knot, in active competition with the speed attained by the wire-stitching machines.

It runs at the rate of 48 stitches complete per minute, and its capacity per day ranges from 10,000 to 20,000, according to the class of work and ability of the operator.

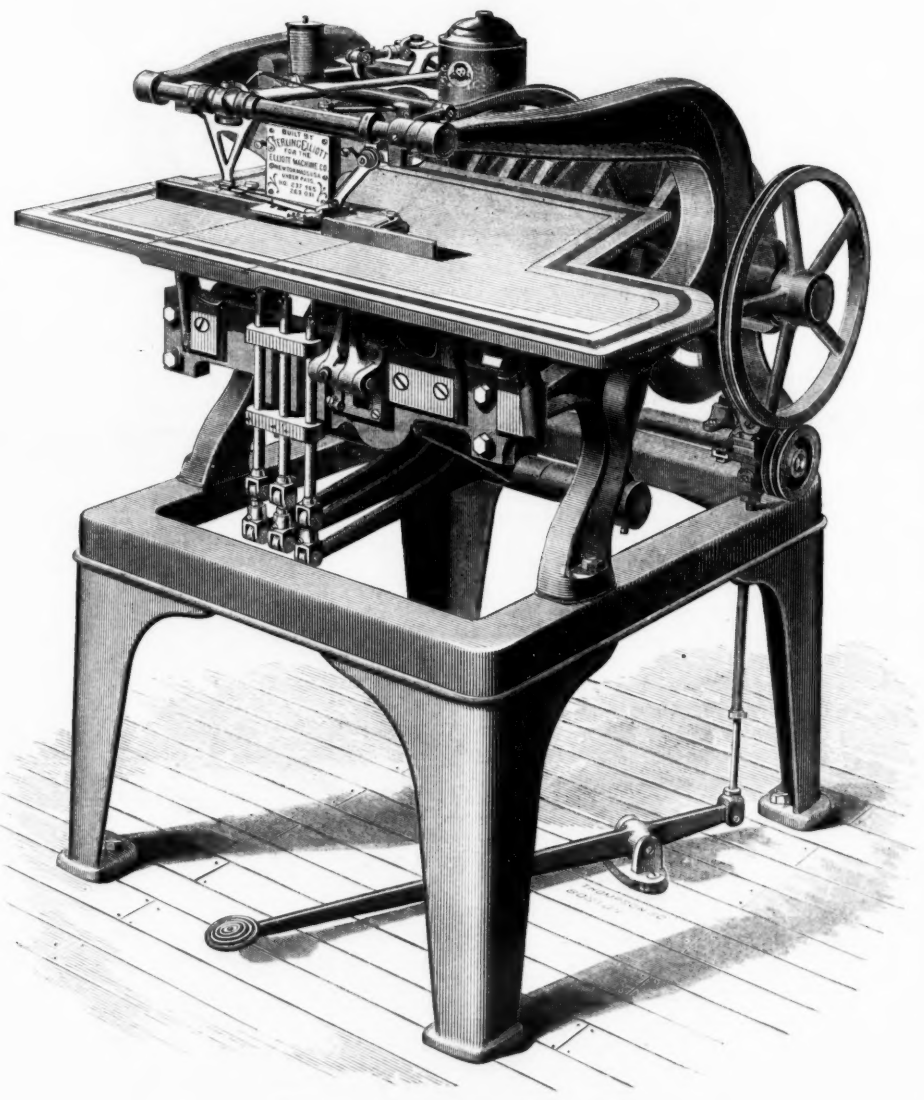
As a machine, it also has some very ingenious points, all tending toward simplification. As an engineer expressed himself, "It contains much omitted and nothing forgotten." It has only one shaft and no gears. Cams are all round and of same diameter outside; in fact, cast from one pattern. They are cut from the solid metal by special machines. The cams consist of a disk, backed up with six ribs or arms; the groove is cut entirely through the disk, leaving the cam rollers in plain sight from back of cam, and also enables the rollers and studs to be taken out without disturbing any other part of the machine.

All the connections are adjustable by screw arrangement, which is solid and cannot change or work loose, and yet may be adjusted to the $\frac{1}{40}$th of an inch. This is of great usefulness as a means of adjustment in taking up any possible wear, and the saving it accomplishes in building a perfect machine is incalculable.

The machine makes a perfect stitch, ties a square knot and *cuts off*, all in one operation, with either linen, cotton or silk thread.

The operation of the machine is in some respects similar to that of a sewing machine, though the needles do not require threading as in the sewing machine. In this machine, for ordinary work, three needles are used, and what serves the purpose of a shuttle.

Machines are already in practical operation in New York City, Hartford and Boston. Frank L. Montague is general agent; office, 113 Fulton street, N. Y.



STITCHER AND KNOT-TYING MACHINE.

Sinfulness in Shafting.

BY OBERLIN SMITH.

To make the matter more clear, I will say that the *sinfulness* referred to is in the makers, putters-up and users of shafting, and when I use the term "sinfulness in shafting" it must be understood to mean that a certain amount of depravity is embodied in it without election of its own. It will be well to explain that the term shafting is here used in its general sense, including not merely the shafts themselves, but the couplings which connect them, the hangers in which they run, and the pulleys and belts by which they are driven and through which they convey power to other machines. Thus the "shafting" of a mill often means all the apparatus for the transmission of power, although I must confess that I do not usually approve of such a loose system of nomenclature, thinking that there certainly should be a proper and exclusive word to express the meaning above indicated.

In considering this subject, I will take no account of the unpardonable sin of using square or octagonal wooden shafting, mounted, perhaps, with iron bands and gudgeons, and perforated for the spokes of wooden pulleys, as perpetrated by our grandfathers, nor will I consider the manner in which our fathers sinned a sin by using square iron bars turned down at their journals to about half the torsional strength incident to the remainder of the bar, and having their pulleys fastened upon them by eight or sixteen wedges, which when once loosened, required to replace them several hours' use of the hammer, a piece of chalk, a boss operator and a boy to pull the thing around.

Leaving these things as relics of a barbarous age, the reader will be herein asked to consider only reasonable, decent modern shafting, varying somewhat, of course, in moral purity and consequent usefulness, according to its maker's common sense, and also the purse of its user.

The first requirement in a good line of *shafting* is to have it round, straight, and of uniform diameter; and the next is to have the various sections securely coupled together in such a way that their axes will come exactly in line with each other. There are in the market numerous kinds of shaft couplings, but the preference should, I think, be given to some form of *clamp coupling*, which will independently grip the two shaft ends that enter it—even when they vary somewhat from their standard nominal diameter, and when they are different from each other. These couplings should be capable of certain and easy removal, preferably not requiring the shafts to be shoved endwise to any great entent.

The putting of them on should, of course, be a still easier matter, when there is no rust or battered-up edges to contend with. It is also best that they should be turned cylindrically upon the outside so that they may answer for pulleys if required. The various *plate couplings* in the market answer an excellent purpose when properly made and put on (which they often are not), but are usually difficult to remove, and require that the shafting should be of very exact diameter to fit them properly. In fact, to secure this object, the ends of the shafts are often turned smaller, which is a foolish practice, as it weakens the shaft and is a useless expense. Many mills, however, with beautifully running, and unsinful shafting, are supplied with such couplings, and their owners declare that they will not have any other kind.

The next requisite in a line of shafting is that it should run in *bearings* which are swiveled to their supports, be they hangers, pillow-blocks or "post hangers," thus enabling the bearings to adjust and keep themselves perfectly in line, and thereby to have the frictional running pressure distributed evenly throughout their length. It is scarcely necessary to say, in this age of mechanical civilization, that the bearings should be very long, say, not less than four times the shaft's diameter.

The object of this is, of course, to make them more durable as regards wear, and to lessen the pressure per square inch; that the lubricant used may be more easily retained, and the metal of the shaft and bearing be less liable to heating and abrasion. It is true that when a lubricant is used, the friction is somewhat increased by lengthening the bearing, on account of the viscosity of said lubricant, and of the dirt that may be mixed with it; but this is a small matter compared with the disadvantage of the old-fashioned short bearings. Of course the principle is well known that, so far as metallic friction itself goes, there is no disadvantage in lengthening the bearings, this friction being independent of the amount of surface, and dependent only upon pressure and speed. The reason that still longer bearings are not usually desirable is that shafting is apt to spring slightly out of a straight line on account of its own weight, or that of the pulleys upon it—also by the pull of the various belts which travel upon said pulleys. When this bending of the shaft occurs to any great extent within the bearing itself, it of course defeats the object of a long bearing; there is, therefore, a limitation in this direction. In regard to *hangers* and other bearing supports themselves, it may be said that they should be amply strong, easily fastened to beams, posts or other parts of the building to which they are fitted, and capable of ready adjustment in two directions, at right angles

to each other, and both at right angles to the axis of the shafting. This, of course, is in order that the line of shafting may be placed exactly in the position wanted, and also, that all the bearings may have their axes in one straight line—not at first only, but at proper intervals of time afterwards, when the settling of the building or the shrinking of timbers may have thrown them out of alignment.

The arrangements for *lubricating* the bearings and for catching the waste oil should obviously be as perfect as possible, and the preference should be given to some so-called "self-oiling" device that may have proved itself useful and dependable, so as to avoid the frequent hand-oiling, at intervals of every five or six hours, which is so frequently practiced. It may here be said that this self-oiling principle should also be used upon loose pulleys, there being now several devices in the market which will enable such pulleys to run from one to two weeks without attention.

In regard to *pulleys* upon shafting, it hardly need be stated that they should have a truly turned belt-surface and edges, and that they should be carefully balanced—unless indeed they run at exceptionally slow speeds. They should, for convenience of removal and of changing their position, be fastened with set screws or some clamping device, except in the case of very large pulleys which act as main drivers and receivers of power, which latter it is sometimes better to have keyed upon their shafts. Obviously, however, the old-fashioned method of keying all pulleys to shafts is far too expensive and troublesome for modern practice. In regard to the vexed question of *whole* or *split* pulleys, it may be said that the former are cheaper, neater and lighter, as well as truer running and less liable to get out of order than the latter. On the other hand, a man who has fitted out his factory with whole pulleys, and then has frequent occasion for changing speeds, on account of putting new machines upon his floors and shifting old ones, is sure to suffer grievous vexation of spirit, if not to damage by the style of his conversation, his prospects for any deaconship he may be looking after; and all this because he ever had the misfortune to see such a thing as a whole pulley. Under such circumstances his yearnings for a complete supply of split pulleys are often very tender and far reaching. This is especially apt to be the case in a machine shop where there are a great many kinds of machines mixed up upon the floor, and where a natural growth in the quality and capacity of plant necessitates frequent shifting of machines, and consequent change of pulleys. For such and similar conditions, a complete outfit of split pulleys is certainly to be recommended, while in such a place as a cotton mill, where hundreds of machines, all alike, are placed upon the floor, according to a certain system, and will probably remain there for years, whole pulleys are in every way preferable. Another matter of importance is that pulleys should be *wider* than the belts running upon them—say from one to two inches. They should also be "high" (that is, of larger diameter in the center, so that the face is convex) where the belt is not to be shifted to different positions upon them, but runs steadily in one place, or is shifted entirely off. Hence for a non-shifting belt both pulleys should be high; while for a shifting belt the double width pulley should be "straight" (cylindrical), and the "fast" and "loose" pulleys should each be high. Of course pulleys connected by a belt should always be set properly in alignment.

Regarding *belts*, there is not very much to be said, except that they should be of the best quality, and preferably of leather, although good rubber belts answer an excellent purpose where they do not rub against anything, and are fully protected from grease. Any belt should, of course, be laced or otherwise fastened at the joints, so as to have its edges in perfectly straight lines, and the joints should be strong and as thin and flexible as possible. They should run without touching anything except their pulleys, wherever this is practicable. All shipper arms should be set far enough apart not to touch the edges of the belt, except during the act of shifting. Cross-belts and quarter-twist belts should be arrangrd of as great length as possible—that is, with the connected shafts at a considerable distance apart, so as to avoid undue friction and uneven stretching of the belt. An evil to be carefully shunned is the stretching of belts too tight upon their pulleys, which not only damages the belt and tears apart the joints, but wastes a great deal of valuable power.

In regard to *speed* of shafting and belting, the golden rule is to *run it faster*. I say "faster," because the great and crying evil in many of our shops and mills is a set of power-transmission plant groaning and travailing at speeds averaging, perhaps, one-half as fast as they ought to be, and trying to carry the power required by straining everything to its utmost; perhaps increasing belt adhesion by copious doses of neatsfoot oil and powdered rosin—attempting to glue the belts fast to the pulleys, so to speak, in order to carry the power which could be conveyed so easily at a higher speed. The truth of the matter is that most machinery users have never imbibed one of the primal ideas of dynamics, namely, that power is the product of three factors, *force*, *space* and *inverse-time*, briefly expressed by the formula:

$$P = F S \frac{1}{T}$$

wherein P=power, F=force, S=space and T=time. Few of them seem to realize that small quick-running shafting, with pulleys of large diameter, and narrow belts traveling at a high velocity, would give them the power they seek much better than the present cumbrous and slow-moving apparatus. Even machinists, who are supposed to be trained to special knowledge in such matters, have frequently little realization of the importance of speed as an element of power, and many a foreman of a moderate-sized machine shop can be astonished almost out of his boots by being told that his shop could easily be run with a one-inch belt. A good general rule is to run belting as fast as circumstances will permit, so that it does not exceed about 6,000 feet per minute. Above this speed, the tendency of the belt to loosen itself from the pulleys by centrifugal action is so great that a limit of economy is soon reached.

The reader may here observe that this sermon is wandering somewhat away from its text, and, as is the case with many other sermons, *sinfulness* is being described and illustrated by the law of contrasts, that is, by stating a number of conditions which tend toward the opposite state of righteousness. Having therefore, described such generally righteous conditions as pertain to shafting when not in a state of sin, there remains for me but to briefly note some of the practical wickedness which curdles the soul of the visitor to many of our American factories. Among these are shafts that seem to have been treated like the Irishman's gun-barrel, which was bent so as to shoot around a corner. These, perhaps, have couplings striving vainly to hold them in line, and squeakingly chewing up the metal belonging to the shafts and themselves until somebody pours a few gills of oil over them, after which they grind in silence till they have succeeded in squeezing the oil out again, when their plaintive song is once more renewed. The crime and sorrow in such a shop is perhaps aggravated by rigid journal bearings which cannot fit the shafts at more than one spot at a time, and which are frequently heating themselves, up to a state of fiery wrath. If the bearings are swiveled, they are perhaps set so much out of alignment as to make the whole line of shafting seem something like the crankshafts which we see upon the shaking apparatus of threshing machines, where each particular part of the shaft seems to have started out to attend to its own individual business, and is regardless of everybody else's. In this model shop many of the pulleys are probably out of balance, but this may very likely not signify, as the motion is too slow to cause any shaking which will overpower the other and greater shaking due to the crookedness of the shafting. These pulleys will probably be found padded up on the outside with dusky and gummy excrescences made of dirt and rosin, while the tightly strained and groaning belts will have their edges cracked and turned outward into a fringy flange, by rubbing against pieces of stick nailed to the joists above, to keep them from abandoning the pulleys with which the gummy rosin is vainly endeavoring to keep them united. In many places the belts will be found to run from one to two inches beyond the edges of their pulleys, at any rate, in spots; for such belts are very apt to have as many graceful curves and scallops in their edges, as we see on the mysterious articles advertised in the fashion papers as Mrs. So-and-So's "age-exterminating wave."

While the running of such a shop as has been described may be called *dynamic* sinfulness, a condition of *static* sinfulness may usually be discovered therein about 11 o'clock on Saturday night, when a gang-boss and a number of the apprentice boys have grudgingly spent an evening (which they fondly hoped to devote to visiting the circus or their grandmother's grave, or some other equally pleasant amusement) in trying to repair a few couplings, change over some pulleys to an adjacent length of shafting, line up some hangers, etc. It is, perhaps, well for the morals of the country that that silver-tongued instrument, known as the *phonograph*, has never yet been perfected into practical shape. Otherwise the proprietor of the shop in question might be tempted to hide one behind the steam pipes or somewhere, so that it could record the conversation occurring during such an evening *seance* as has been spoken of. Could the curses, loud and deep, and all the other naughty words which have been the only practicable safety-valves to keep the boys and the bosses from bursting with wrath, be thus recorded, the phonographs themselves would become so imbued with inherent sin that their reputation would be forever ruined, as also would the morals of all who tinker with shafting that is put up on the get-out-of-order-ative and not-come-apart-if-it-can-help-it-ative principle. It may be, however, that the boys "must work" and their bosses "must weep" to an accompaniment of naughty vocal music, so that, in accordance with the general law of pain and evil, and somewhat upon the principle of a clairvoyant absorbing the headache away from his victim, there may be gradually evoluted out of it, as the eons roll on, the sinfulness in shafting.

NEW FOOT LATHE.

New Foot-Lathe.

This lathe is one recently brought out by the Seneca Falls Manufacturing Company, Seneca Falls, N. Y. The lathe shown in cut will swing 10 inches, and take 24 inches between centers; longer beds are made if desired.

It has double treadles with walking motion; treadles are movable, and work independently of each other. Both treadles may be worked sitting, or one standing. The driving wheel is 26 inches diameter, with two changes of speed for one-inch flat belt. The head-stock has hollow steel spindle, and brass boxes, adjustable for wear. The tail-stock has steel spindle; centers are No. 1, Morse taper.

Each lathe is provided with one single and one double rest, one face-plate (screwed to spindle) and the necessary belt. When desired, a compound slide-rest is furnished; with this work can be turned straight or tapering, and work faced-up to the full capacity of lathe. A bevel rest permits the vertical adjustment of tool without altering its pitch. An attachment for using circular saws for ripping, cross-cutting, mitering, etc., is also furnished on order.

A Special Electric Light at the Novelties Exposition.

The Search Light loaned by the Government has been worked nearly every evening, Saturday evening October 31, being very clear, the light gave its best results.

About 400 rods appear to be the limit of usefulness of the light on land, but it is probably effective a little further at sea.

At 300 rods men could be plainly seen, and light colored objects of smaller size made out. The direct rays are entirely cut off by a small mirror in front of the lamp. By three reflections, and refractions, the rays are reduced to nearly parallel lines.

The carbons, which are $\frac{3}{4}$ in. diameter, are adjusted by hand and are not automatic, as in the ordinary arc lamp. Nearly the entire light comes from the upper carbon, and as it burns away twice as fast as the lower one, it must be adjusted very often.

A mirror arranged at the side of the lamp, at an angle of 45 degrees, enables the operator to line the carbons which meet at an angle of about 165 or 170 degrees, while a small opening in the center of the silvered mirror gives a "quartering" view of the carbons, and they can be kept "plumb" in that direction also.

We notice that our English contemporaries are giving considerable attention to an explanation of the reason why shipments of American pig iron have been made to England. We remember some years since a pleasant conversation with an English manufacturer, who was on a visit of observation to this country. During the conversation we showed him some samples of malleable iron that had been submitted to a test, and had come back with the strain at which they broke marked on them. "This shows," said he "why you can make so many parts of machines of malleable, or even of cast-iron, which we must make of wrought-iron. If we had," he continued, "the cast-iron from which we could make malleable castings that would stand that stress we could revolutionize much of our machine shop practice."

We offer these remarks of an intelligent and wide-awake English machinist as an explanation of why American iron is bought in England.

Fair of the American Institute.

This exhibition has got into good running condition, and appears to attract about the usual number of visitors. The display of wares that attract the children and curiosity seekers is as good as ever, but the show of machinery, especially so far as novelty is concerned, is hardly up to the average. There are, however, some excellent displays in this line, that are well worth looking at.

In machine tools E. Gould & Eberhardt, Newark, N. J., have one of their automatic gear cutters operating on regular shop work. They also have under belt one of their latest examples of upright drill presses, which is well worth critical examination. A planer by this firm has return motion four to one, and changes motion without jar or tremble. They have also several engine lathes, a quick-stopping hand lathe and a tool-grinder; the latter is frequently tried by mechanics.

E. E. Garvin & Co., New York, have on exhibition, many of them at work, several sizes of milling machines, screw machines, drilling machines—single and multiple spindle—gear cutters and other machines in their line, all of which attract attention from their fine finish. A small screw machine has an excellent arrangement for a lever chuck, and stop motion. Its rapidity of action is very well shown by using it for cutting up tubing into short lengths. The feeding along to exact length for which it is adjusted is accomplished automatically by the operation of a weight.

The Stiles & Parker Press Co., Middletown, Conn., and 59 Duane street, New York, have a fine exhibit of foot and power presses in a variety of sizes; they also exhibit a rotary shear, a squaring shear and a hundred-pound drop hammer. The hammer is noticeable from the certainty with which the drop can be manipulated and stopped at any point in its upward or downward motion. This firm show a corundum wheel tool-grinder which visitors are invited to try. The general verdict is that it is a long way ahead of a grindstone.

In steam engines Wheelock has an 11″ × 30″ at work. This engine is fitted with his new multi-ported valve. The seat is removable for repairs, or a new one may be substituted in a few minutes. With the many ports the movement is small and the opening quick.

The New York Safety Steam Power Company show one of their new high-speed automatic single-valve horizontal engines in motion. It runs very smoothly. They also show a small vertical automatic driving an Edison dynamo by means of four wire belts.

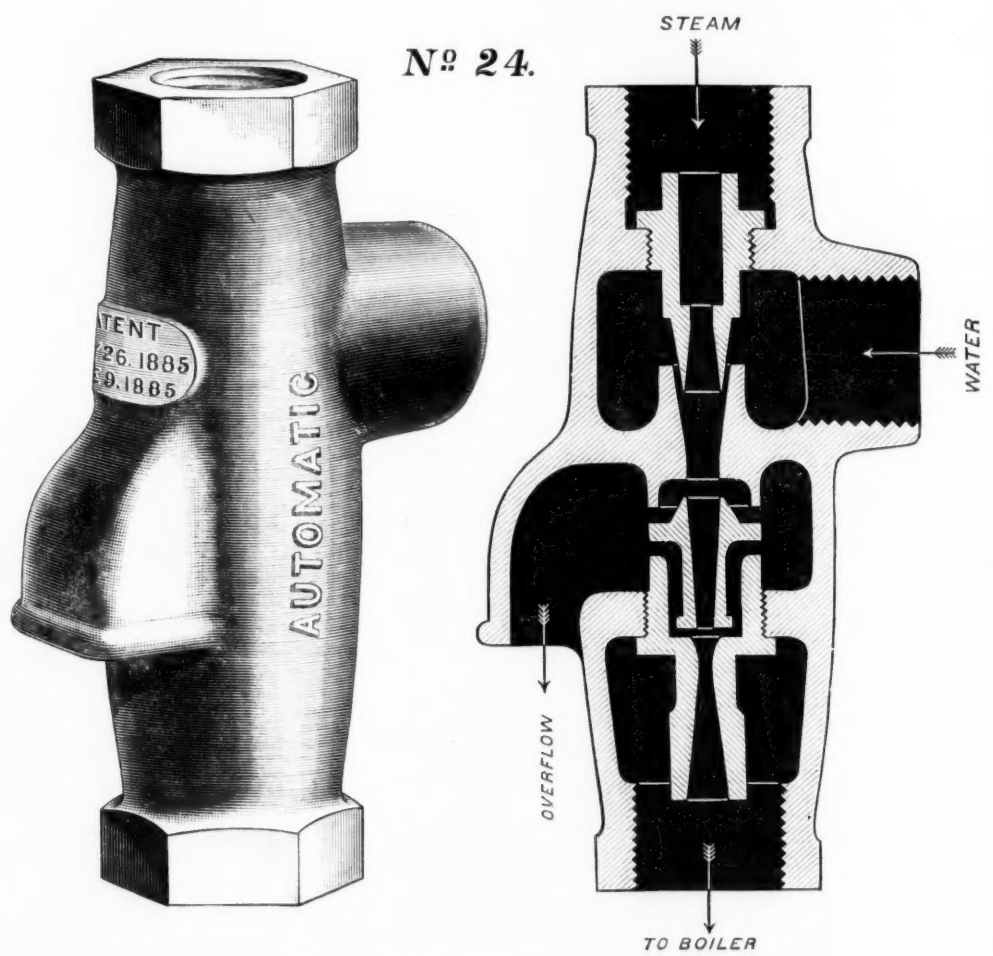
On these engines B. P. Rider, 14 Dey street, New York, exhibits the Harlow cylinder lubricator. This is a species of pump driven from the valve rod; the cup is provided with sight feed, and ready means for accurately gauging the quantity of oil supplied to the cylinder.

There are a liberal number of gas engines on exhibition. The "Otto" is shown in several sizes. A combined Otto engine and pump, capacity 7,500 gallons 100 feet high per hour is in operation and does its work in a very satisfactory manner.

The Parker gas engine, built by the Yonkers (N. Y.) Manufacturing Company, is also on exhibition, but at this writing is not completely arranged for operation.

A. Aller, 109 Liberty street, New York, shows a line of his specialties, including the Korting injector and a variety of steam jet machinery, duplex pumps, steam traps, etc. He makes steam connection with the Curtis damper regulator (for which he is agent) in such a way as to show its operation. As arranged it opens and closes at a variation of one pound pressure.

The Nathan Manufacturing Company, 92 Liberty street, New York, exhibit injectors, cylinder lubricators, oil cups and other specialties. They have attached to the boiler one of the small injectors which we illustrate in this issue. Its action challenges the attention of engineers who see it work.



THE GRESHAM AUTOMATIC RE-STARTING INJECTOR.

An Established Co-operative Library.

General M. C. Meigs writes us from Washington, D. C., on the above subject as follows:

Your editorial in the AMERICAN MACHINIST of 31st October, on "Co-operative Technical Libraries," induces me to send you the blank forms used by a book club which has been in successful operation in this city for many years. It has no officers, except a secretary, who is also treasurer. Two other members act as an advisory committee to determine what books shall be purchased. Any member, on a postal card addressed to the secretary, can recommend any book he thinks suited to the objects of the club. Once a year only the club meets, elects the secretary and treasurer, and fixes the annual contribution of each member.

Booksellers sell to the club at a discount, and the secretary marks in each book, when started on its rounds, the price at which any member first writing his name in the blank form under the cover may take it after the book has completed its course.

The selling price is one-half the entire reduced cost price. It is easy on this plan to found a co-operative library on any theme.

We confine our list to about twenty-five members.

The yearly contribution the first year was $5, or perhaps $10; now $3 keeps us supplied with books.

We are all busy, and the only complaint heard is that we get more books than we have time to read deliberately.

The "Regulations of the First Washington Book Club" are as follows:

I. The members will receive the books from each other in the order of the following list:

II. Each member will record, in ink, when received and when delivered.

III. The time allowed for retaining each book will be stated, and should not be exceeded.

IV. Always endeavor to preserve an equal distribution of books, by forwarding one at a time, to prevent accumulation. This may be done by hastening with a volume when you know your neighbor has none, or by retaining a book after reading it, the time allowed, should he have a supply.

V. Any member wishing to read a book the second time will signify it by underscoring his name in the list, and the secretary will forward the book as soon as it has completed its circuit.

VI. The time of an absentee is allowed to the next succeeding member. In like manner, when the circuit of a book terminates with an absentee, to the preceding member.

VII. Notify the secretary, by letter, when you propose leaving town, and cannot receive books, and again when you return.

VIII. The price of each book (half its cost) will be marked on the cover. A member desiring to purchase will write his name after the words "Sold to." Books will be delivered as soon as their circulation is completed.

IX. Cut the leaves with care, and do not deface them.

X. Members are requested to advise the secretary, in writing, of the titles of books they desire to have purchased from time to time. All such communications will be laid before the committee on purchase of books.

XI. No new member shall be admitted, except on payment of the assessment in advance, and any member holding over, who shall not pay the assessment for the current year, on or before January 31st, shall be dropped from the rolls.

FINES.—One cent a day for keeping a book beyond its stated time.

Fines should be sent to the secretary. Funds resulting from fines and sales will be appropriated to the purchase of other books.

A blank form, with the appended heading, is used. At the bottom is the address of the secretary and treasurer, H. L. Prince, 6th and D streets, N. W., Washington.

No.....Selling price, $.....
Keep this book.....days.
Started..... .....Turned in..... .....
Sold to..... . ...

NAME. RESIDENCE. RECEIVED. DELIVERED.

A correspondent, who frequently favors the AMERICAN MACHINIST with practical articles, writes as follows: "Arbitrary rules for doing the thousand-and-one things which come to a mechanic's hands to do are as plenty as blackberries. They can be read from the books, or got by word of mouth, or from communications from the pens of precise writers, who deal in signs and figures and facts, to be contradicted in the next issue of the paper in which their letters appear. I prefer to write as imagining myself with sleeves rolled up, wrestling with jobs as they come along, always with the idea that it is not altogether necessary for me to do this way or that, because Jones or Smith does it so, but to do that which admits of finding a good reason for its being right. There are old ways which will never be beaten. There are new ways brought out daily by boys which beat old ways out of sight. Anything to keep them thinking, I say."

The Gresham Automatic Re-starting Injector.

We present with this a perspective view and sectional elevation of this injector complete, and full size, of No. 24 instrument. It will be seen to be of very simple construction, no other parts than those shown being required. All that is necessary in working is to open an ordinary valve in the steam and one in the water pipe.

The automatic principle involved in their construction enables these injectors not only to start instantly, but to work equally well at any steam pressure. It also enables them to be placed in any position either above or below the water supply, lifting the water, if required, sixteen feet. They will also take up feed water of a high temperature.

Another and important feature of the automatic principle is the capacity of the injector to start again without any manipulation, after having been stopped by temporary interruption of water supply. On traction and farm engines the water supply is likely to be suddenly stopped by running over stony and uneven ground; also, on tugboats and steamers, the supply is likely to be inconstant. This is also frequently the case when water is taken from service pipes of city water works. With these injectors no attention is paid to inconstant supply; as soon as the water supply is restored, they take it up and begin working as if there had been no interruption. This is accomplished by the action of the single loose piece inside. With the injector at work the pressure underneath keeps this piece up, completing the connection for the direct delivery of water to the boiler. If, now, the water supply fails, this piece drops down, giving an ample escape to the steam through the overflow. The escaping steam, by induction, exhausts the air, keeping up a partial vacuum or constant suction on the water pipe, which, as soon as the water supply is again provided, lifts it, which raises the loose piece and the injector resumes feeding. Steam never blows through the water pipe, hence it is never warmer than the feed water, or the air.

The Nathan Manufacturing Company, 92 and 94 Liberty street, New York, are sole agents for the manufacture and sale of these injectors in the United States and Canada.

We have received an invitation, in the highest style of typographical art, to attend the fourth annual ball of the Chicago Association of Stationary Engineers No. 1, on Tuesday evening, Nov. 17th. The invitation is extended to "yourself and ladies." We are too busy ourself to attend, and the ladies have not yet decided on the proper selection of winter bonnet in which to visit Chicago. The Engineers will no doubt have a pleasant time, which they well deserve.

Cutting Spiral and Spur Gears on a Milling Machine With a Side Tool.

BY O. J. BEALE.

Since your issue of Sept. 12th, I have extended the application of the principle there given for cutting spiral gears.

If a side-tool *A*, Fig. 2, is held in fly-cutter holder *B*, and the cutting-edge *A*, is perpendicular to the center of spindle *S*, then when spindle is turning the edge, *A* describes a plane surface. The outline of this surface is, of course, circular. This principle enables us to cut spiral gears in the Universal milling machine without the planing attachment. Theoretically, all spiral gears can be cut in this way, but there may be a practical limit on account of the curved outline of the plane surface developed by the tool.

The end-wise movement of the spiral bed *C*, Fig. 1, accompanied by the turning of index spindle *D*, gives the helical grooves in milling. The spiral bed *C*, being set to an angle not perpendicular to the cutter spindle *S*, makes the work also move sidewise as the bed *C*, advances. Now, these movements, when cutting with a side-tool, conform to the condition of unwinding a line from a cylinder, as in Fig. 3, generating the involute of a circle. The circle *E F G*, from which the line *E H* unwinds is called the base circle. The end *H*, of the line *E H*, started at *G*, and in going to *H*, has made the involute *G H*. In the case of our spiral gear the base circle *E F G*, rolls upon its uppermost part, the line *E H*, as the base circle rolls; not changing from a horizontal position. This rolling does not take place directly under the cutter spindle, but after the gear passes the spindle. The involute is a form often taken for the teeth of gear wheels. Such teeth are called single curve teeth. In the common system of single curve gearing, the diameter of the base circle is .968 of the diameter of pitch circle. By adhering to a constant ratio of base circle to pitch circle the interchangeability of gears is secured.

In setting the machine to cut spiral gears with a side tool, replacing the ordinary rotary disk cutter, the calculations for lead of spiral and angular setting of bed *C*, Fig. 1, are made upon the base circle of the involute. When the contour of cutter gives the shape to teeth of spiral gears, the lead of spiral and angular setting of bed are calculated at the surface of the pitch cylinder of gear. In cutting spiral gears with the fly-tool, the lead of the spiral should be such as to give the required angular relation of teeth to the axis of gear at the pitch cylinder, but the angular setting must be made for the base circle. This means that the same spiral lead or pitch can be used for different base circles by a simple change of angular setting of bed *C*. When the tool was in full cut it acted upon one side of a tooth, between root and point of tooth, at each revolution of cutter-spindle. Theoretically, with a tool of right thickness, having two parallel cutting edges, both sides of a space can be finished at one operation. Three spiral gears were made—two right-hand, and one left-hand spiral. It will be remembered that these spiral gears were cut upon the regular milling machine centers, and not upon the arbor shown in Figs. 1 and 2. The left-hand and one of the right-hand gears were placed in mesh upon parallel shafts; the two right-hand gears also were in mesh upon shafts not parallel. The three gears worked very accurately together.

Now, by the addition of planer centers *I K*, Fig. 1, bolted to spiral bed *C*, several spur gears were cut. The centers *I K*, are placed at right angles to spindle *S*. The equal gears *L M*, connect the arbor holding the gear to be cut, *N*, with the index spindle *D*. When the bed *C* advances in an angular direction, the centers *I K* in effect move sidewise, while the spur gear to be cut, *N*, is turned by gears *L* and *M*. Again, we have the action of a cylinder rolling upon its uppermost part, unrolling the line *E H*, Fig. 3, generating the involute *G H*. When cutting spiral gears, if we are able to cut a thin spiral gear, we can cut one of any width of face with the same arrangement, but when arranged to cut a thin spur gear it does not follow that we can cut a spur gear of wide face; the spur gear is soon out of reach of the circular path of end of fly-tool, and, of course, cannot then be acted upon by the tool; yet this arrangement is important, as it will enable any mechanic who has a Universal milling machine to get the accurate outline of involute gear teeth.

For wide-face gears, a tool moving in a straight path would give the required results. This was described in the AMERICAN MACHINIST of September 12. A machine involving these principles would have considerable scientific interest, but users of gears might not care to pay for the product.

In this, as in every machine where teeth are planed, the integrity of the tool must be preserved throughout all the cuts.

Should further thought and experiment warrant, it is my intention to construct a machine based upon the principles shown in the foregoing.

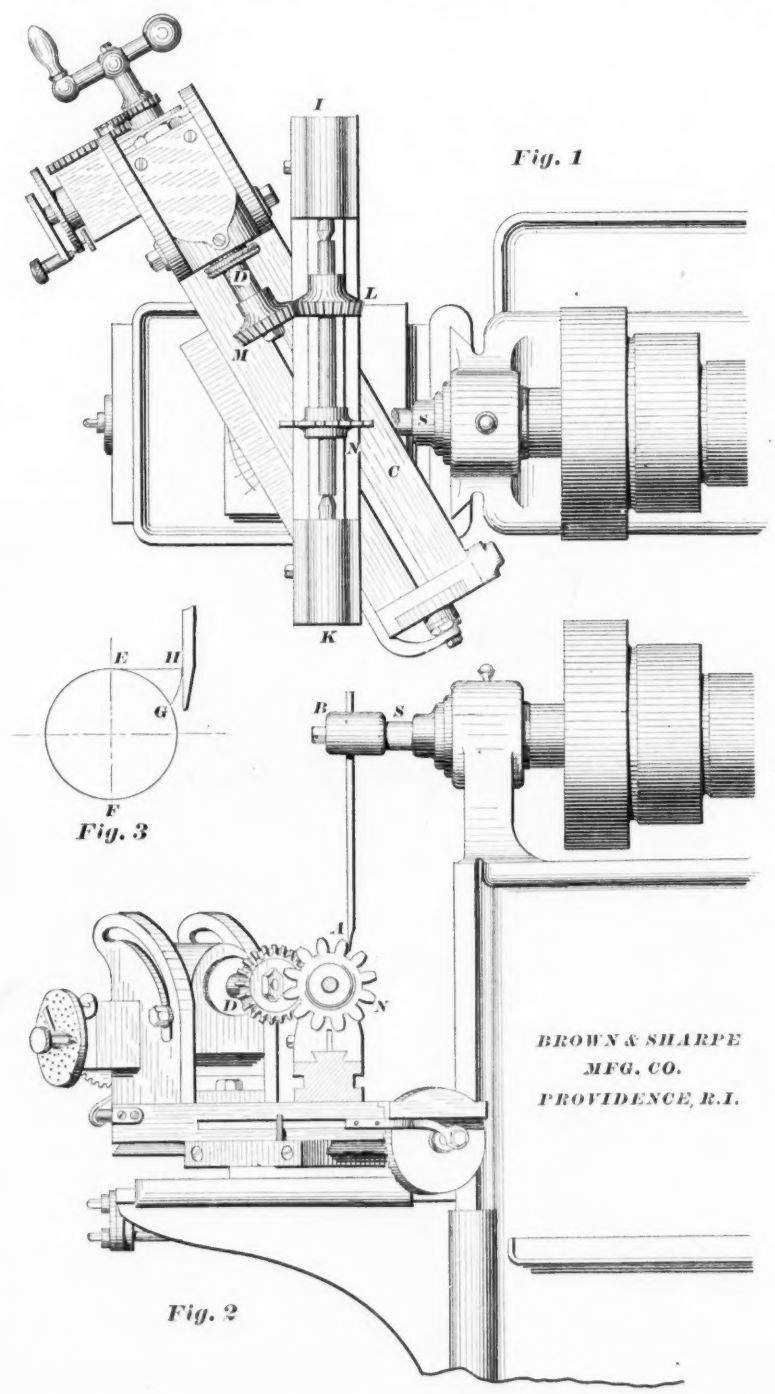


Fig. 1

Fig. 3

Fig. 2

Gen. M. C. Meigs writes us from Washington, D. C., explaining details of the working of a successful library on the co-operative plan, established in that city. As the most troublesome part of the inauguration of such enterprises is generally the painstaking elaboration of the minor methods necessary to success, we publish them in full on another page, enabling our readers in other cities and towns, who desire to profit by the experience of the Washington co-operators, to make a fairer start than might otherwise be the case.

The problem of furnishing steam fire engines with electric light is being agitated.

Making Models for Inventors—Dewers' System of Time Keeping—Fire Pumps.

BY JAMES F. HOBART.

Once in a while a man will come into the shop one side at a time, and inquire for the boss.

He is pretty apt to get the boss into the back office, or behind the tool-room door, and after looking all around he will pull a wooden concern out of his pocket, and say: "Look here, now, I want you to make me something like this, only make it half an inch longer here, and put a couple of gears there in place of those pulleys; and I want that plate $\frac{1}{8}$" thicker, and a little wider, so much longer, and this end rounded. Make it just exactly like this, only do what I told you, and put screws in there instead of pins, and"—— "Hold on a minute," you say, "what's this thing to do, anyway? Just you tell me what work you want it to do and perhaps I can help you a little."

"What! tell you all about it? No, sir; you bet I won't. Why, man, I'm going to have that thing patented, and make a fortune out of it. I'd look well giving it away to you, wouldn't I?"

And so it goes on. You make the thing; you try to do the best way possible, and get a part done just as he tells you of something else he wants done which calls for an entirely different arrangement of the first part.

He has got some ideas, and he don't know enough of mechanics to tell whether his ideas are practical or not. He is afraid to tell about them, and you cannot convince him that they are safe with you, and that if he would give you the whole business, you could help him out of his trouble.

Model makers, and builders of experimental machinery, are not in the habit of stealing their customers' inventions, but they can save hundreds of dollars for them if the whole thing is explained to them.

Just imagine a man on trial for a grave offence who does not confide all the facts of the case to his counsel. What kind of a case could the lawyer get up, if the client said "do this so, and that thus?"

Perhaps the lawyer will not take the case upon hearing the facts. Just so with the mechanic. He may see that the ideas are worthless, and by refusing the job will save dollars from being wasted in a useless concern.

If the inventor won't do this, the best thing to do is to charge him so much he won't come again.

Machinists are not apt to steal inventions which they are helping to develop. It is the outside chap who does that business.

He comes along while experiments are being made to perfect some defective point. He takes in the whole situation at a glance, an idea strikes him and he clears out.

The first we hear of him he has applied for a patent on our invention. Even if we get out our patent, and have our claims all allowed, we are not sure of a good thing out of it; no, not by a good deal.

The inventor of a useful device does not always get the benefit of his work. In fact, the exception to this rule is apt to be the case.

Many inventors cannot push the enterprise. They possess the inventor's abilities, and lack those of the business man. More than one valuable concern has laid in obscurity until someone stole it, or a sharp business chap bought it for a handful of dollars, and then made a fortune out of it.

We happened to be in Dewers' shop the other day just as Mr. Grumpy came in to pay a bill.

"Look here, Dewers," said Mr. Grumpy, "you've charged me with too much time."

"Guess not, Mr. Grumpy."

"Yes you have. There's nine hours' work charged on that cam alone. If a man can't make that thing in half a day he ought to eat it."

"Hold on a minute, Mr. Grumpy, you'll get a hot box if you run so fast. Let's look the matter up, and see if that bill is not all right."

"Don't give a darn for all the lookin' you can do," said Grumpy. "'Cause your books are fixed like your bill."

"All right then, we won't look at the books at all. When was it that the work was done?"

"Done?" "Why it was done last September—about the first of the month—yes, it was the third day of September that I showed your man about that cam."

"All right," said Dewers, and going to a cupboard, he took some papers out of a pigeon-hole marked July 1 to Dec. 31, 1885. Dewers picked out a small bundle, laid it on the desk and put the others back. The package was marked Aug. 31, Sept. 6, 1885.

"Who did the job," asked Dewers.

"Why, that man out there at that lathe," said Grumpy.

"Oh, that's Whitney, and here is his time paper for Thursday, Sept. 3, 1885," said Dewers. "Just look at it, there's 4 hours for turning, 1½ at drilling, and 3½ for polishing, that makes 9 hours, and the other hour was put in for Snyder."

TIME CARD of J. W. Whitney,

For Thursday, 3d day of Sept., 1885.

Grumpy's Cam, Turning.....	4	hours.
" Drilling	1½	"
" Polishing.....	3½	"
Snyder's Model.....		
Turning 3-inch Spindle.....	⅛	"
Drilling Oil-holes.....	½	"
Total hours made this day....	10	

"Well, Whitney must have made a mi-s take then."

"Guess not," said Dewers. "But we will ask him." "Look here Whitney, do you remember that job for Mr. Grumpy?"

"Yes, sir."

"Do you remember the time you worked on it?"

"No sir; it was too long ago, you can find it on the time card, can't you?"

"Yes, I can, but are you sure the card is all right?" "Of course it is right. There is no chance for a mistake. That card is right, and I will swear to it."

Grumpy growled a little more, and paid the bill.

"The best method I ever saw," said Dewers. "You can bring a man right down to hard-pan every time. I copy these slips into my day-book, but I keep the slips and file them away as you see. I bind each week's cards together and mark the date on them."

"Where did you get this method?"

"I'll tell you, Mr. Hobart, I got it out of the AMERICAN MACHINIST. Chordal gave the scheme in one of his letters. I think it was in 1882 or '83. I can tell how and when any job was done since I began to use the system, and I would not part with it for big money.

A fire pump is good to have in a mill or shop, and that is about all it is good for when the fire gets loose.

Perhaps it is a rotary pump down in the wheel-room. You can stop the water-wheel or steam-engine, throw in a clutch coupling, if it is not rusted fast, and go ahead with your pump.

Later you get a friction device of two grooved pulleys; this worked well every time you showed it to the insurance folks, but somebody had let it work into gear and grind the pump pulley almost through. It was n. g. when the fire came.

When the new shop was built you put in a steam fire pump. "Don't amount to a continental," you remarked to your partner, but the insurance men knock off $75 or $100 when they see it.

The new pump works well. Partner organized a fire brigade. He used to put it through a drill every Saturday afternoon.

The boys liked it. It kept the pump and hose in first-class order, and ready for business. One Friday morning the shavings got afire in the pattern shop. Partner had the men out, the pumps working, and extinguished the blaze before the men found out that it was not a false alarm to show to the underwriters.

Brazilians say that, while they can buy iron cheaper in England than in the United States, they regard American engineering as the best. American bridges are lighter in weight, which makes up for the difference in price per pound. American locomotives they consider much better suited to their roads.

How to Increase Our Austrian Trade.

U. S. Consul-General Edmond Jussen writes to the State Department from Vienna:

Among the American manufactures which might possibly find a profitable market in Austria-Hungary I think American watches should stand at the head of the list. Watches are not manufactured in Austria-Hungary. * * *

Almost all the tools in use here are of a clumsy shape, and the imitations of American shapes bear the unmistakable stamp of "counterfeit" on their face. If the exportation of American tools to this empire is pushed with energy and perseverance, it seems as if it were impossible that success should not follow in the end.

But here again an American sample depot, managed by an enterprising American, who has no other end in view than to introduce and sell American wares, would be the main condition of success.

A consignment of samples to an established Austrian business house would be almost useless. The introduction of American goods needs the concentrated energy of an American business man, of an agent who is not hemmed in by other business connections, who does not labor under a prejudice against all novelties and improvements, who has no reverence for the sacredness of old-fashioned shapes and uses, who takes no interest or part in the political and social differences between the German, Czech, and Hungarian elements of this nation, and who, in short, knows nothing of this country but its language and business demands and its opportunities for the sale of American manufactures.

Automatic Tapping Machine.

The engraving of this machine represents one made by E. E. Garvin & Co., of 139-143 Centre street, New York; it is for work under ⅝ diameter of tap. It appears that in running this machine the operator's only duty lies in starting the tap into the work by depressing the hand-lever shown in the illustration. This act throws the feather, which slides in a slot in the spindle, into the right or forward moving clutch; the tap is then followed up by the hand-lever until it has secured a firm start in the work. The hand-lever, on being released, is lifted against the trip-hook by the ball-weight seen at top of the machine, which lifts the feather into the reverse clutch when the spindle has advanced sufficiently far to bring an adjustable cone against the hook to trip it off. When the tap has run out of the hole, it is lifted clear of the work by a counterbalance weight hanging inside of column.

It will be seen by reference to the cut that the countershaft is a part of the machine proper, so arranged as to allow the belt shifter for starting and stopping the machine to be operated by foot motion entirely.

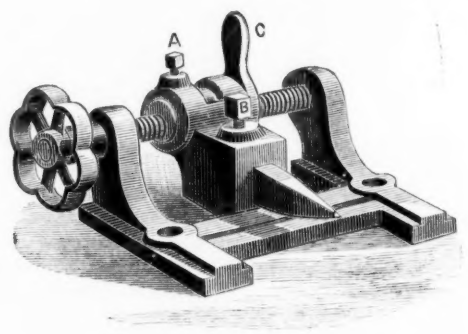
The round table of this machine is 24 inches diameter, constructed so as to swivel on its own center or swing on the axis of the column, upon which it has a long vertical adjustment, operated by lever through rack-and-pinion movement. The rim of this table forms a groove for oil communicating through the radial T slot with the central hub, which is made extra large and cored out for an oil reservoir. Oil can be drawn off by means of the cock underneath. When necessary to use large quantities of oil, a pump is connected.

AUTOMATIC TAPPING MACHINE.

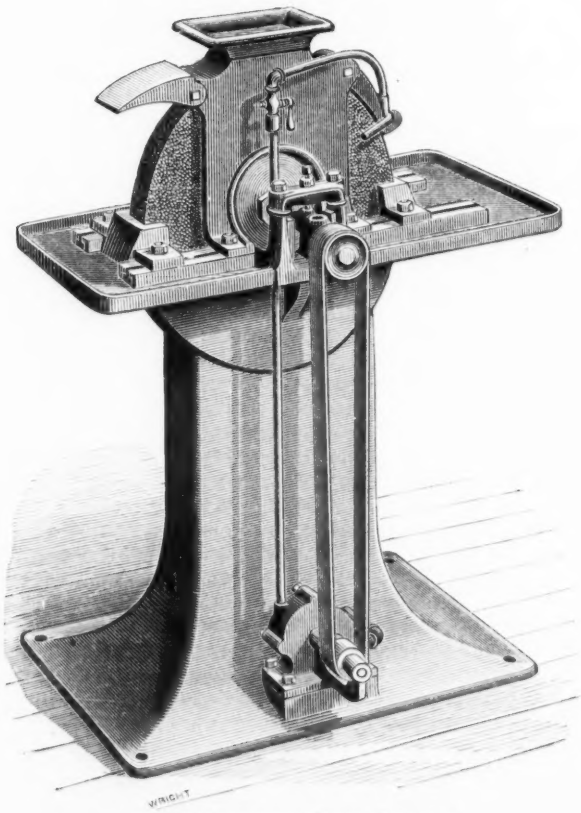
The Stiles Machinists' Tool Grinder.

When the solid corundum wheel first came into use it was of but little service in grinding tools; there were no suitable provisions for keeping the tool cool, so the temper was drawn, and they were not conveniently arranged for tool-grinding; hence attempts to use them for this purpose were failures. But the fast-cutting qualities of such wheels, the excellent quality of the work they would do, coupled to the fact that they could be arranged to occupy but little space, pointed to them as a probable substitute for the more cumbrous grindstone. This led to the devising of means for overcoming such objections to their use as existed, and to putting on the market machines of this class excellently adapted for grinding all kinds of tools.

The engraving with this represents a machine for this purpose, that is neat in appearance and occupies but little floor space. It is made by the Stiles & Parker Press Company, Middletown, Conn., and 59 Duane street, New York. It is arranged, as will be seen, for grinding on either side of the wheel, according to the taste of the individual.



FIXTURE FOR TRUING UP WHEEL.



STILES' MACHINISTS' TOOL GRINDER.

The frame is a hollow casting, forming a reservoir for the water. A small pump, always acting, pumps this water up to the wheel in quantity sufficient to prevent the possibility of injuring the wheel by heat. For clearing out the water reservoir a hand hole, not shown, is provided.

A faucet regulates the amount of water delivered on the wheel, and a short adjustable pipe enables the operator to direct the water to any part of the wheel.

The shaft is of steel, running in self-oiling boxes; all revolving parts are accurately balanced so as to be run on any ordinary floor.

The fixture for truing-up the wheel is shown one-sixth full size. It takes the place of the rest during the operation, carrying a diamond tool.

The machine is designed to allow the operator the entire freedom of his hands for holding work in light tapping or swinging the table in heavier cutting. The least possible responsibility is put upon the operator where an automatic trip and return are employed; work will be of a uniform depth and quickly and squarely done. It is driven by a two and one-half inch belt over cones allowing three changes of speed.

The weight of the machine complete is 675 pounds.

The Study of Engineering.

FROM AN ADDRESS BY PROFESSOR RYAN TO THE STUDENTS OF BRISTOL (ENGLAND) UNIVERSITY.

Nowhere is the injunction of Mr. Lowell, "Don't prophesy unless you know," so applicable as in engineering. The prophets are continually being discredited. It is almost half a century since Dr. Lardner told us that steamships could never carry coal enough for a voyage across the Atlantic. Afterwards we were told by the leading ship builders that iron ships could not swim, and when one or two floated we were told they would not hold together permanently. Later on we were informed that screws could never compete with paddles. Yet the Etruria, a steel screw steamship, crossed the Atlantic last August in less than six days six hours, and it is still solid and intact.

I myself remember very confident assertions in 1877 of the impracticability of electric lighting by the incandescent system; it was asserted to be contrary to scientific principles, and to-day it is an accomplished fact. The Suez Canal was regarded as a wild and foolish scheme, but the energy and skill of a former student of a Parisian technical school brought it to a successful consummation. The application of iron, and later on of steel, to bridges was declared to be out of the question; the utilization of the blast-furnace gases was warranted to spoil the iron. In fine, almost every important advance has been taken in opposition to the prophetic warnings of cautious and conservative engineers. The incredulity and even ridicule with which accounts of Giffard's injector, and the announcement of the discovery of the self-exciting principle in the dynamo were received, should be an encouragement to the engineers of the rising generation not to readily give up any promising field of investigation merely because some one of authority has decided that it must be unproductive. And now I would say to those who intend to follow the profession, don't imagine, because you are able to avail yourselves of instruction of which the last generation of engineers had no conception, that your work will be lighter than theirs. You are able to begin where your predecessors left off; the results of their life work are at your service. Each of you, as Kingsley said, "is heir of all the ages' gain." You must, nevertheless, remember that the struggle is far keener now than it was formerly; that you are called upon to rise to Utopian heights of distinction and excellence. It will not do for you to indicate the site for a bridge by carelessly jerking a stone to the spot you may deem suitable, as a certain Welsh engineer of the timber age is said to have done. You will have to bring many sciences to bear on the selection, and more elaborate instruments than a pebble thrown at hazard. The old empirical, rule-of-thumb engineers would be left hopelessly behind in the present day.

Modern Locomotive Construction.

BY J. G. A. MEYER.

FOURTEENTH PAPER.

LEAD WILL AFFECT THE POINT OF CUT-OFF.

In Fig. 55 the valve had no lead; if, now, in that figure, we change the angular advance of the eccentric so that the valve will have lead, as shown in Fig. 56, then the point of cut-off will also be changed. How to find the point of cut-off when the valve has lead, is shown in Fig. 56.

Example 19.—The lap of valve is 1 inch, its travel 5 inches; lead $\frac{1}{4}$ of an inch (this large amount of lead has been chosen for the sake of clearness in the figure); stroke of piston, 24 inches; at what part of the stroke will the steam be cut off?

On the line $A\ B$, Fig. 56, lay off the exhaust and steam ports; also on this line find the center c of the circle $a\ b\ m$ in a manner similar to that followed in the last construction, namely, by placing the valve in a central position, as shown by the dotted lines, and marked D, and then adopting the edge c of the valve as the center of the circle $a\ b\ m$; or, to use fewer words, we may say from the outside of the edge s of the steam port, lay off on the line $A\ B$ a point c whose distance from the edge s will be equal to the lap, that is, 1 inch. From c as a center, and with a radius of $2\frac{1}{2}$ inches (equal $\frac{1}{2}$ of the travel), describe the circle $a\ b\ m$, whose circumference will represent the path of the center of eccentric. The lead of the valve in a locomotive is generally $\frac{1}{32}$ and sometimes as much as $\frac{1}{16}$ of on inch, when the valve is in full gear, but for the sake of distinctness we have adopted in this construction a lead of $\frac{1}{4}$ of an inch. Draw the section of the valve, as shown in full lines, in a position that it will occupy when the piston is at the beginning of its stroke, and consequently the distance between the edge c_2 of the valve and the edge s of the steam port will, in this case, be $\frac{1}{4}$ of an inch. Through c_2 draw a straight line perpendicular to $A\ B$, intersecting the circumference $a\ b\ m$ in the point y; this point will be the center of the eccentric when the piston is at the beginning of its stroke, and since it is assumed that the circumference $a\ b\ m$ also represents the path of the center of the crank-pin, the point y will also be the position of the same when the piston is at the commencement of its stroke. Through the points y and c draw a straight line $y\ x$, to represent the stroke of the piston, and divide it into 24 equal parts. Through the point s draw a straight line perpendicular to $A\ B$, intersecting the circumference $a\ b\ m$ in the point g, and through g draw a straight line perpendicular to $y\ x$, and intersecting the latter in the point k; this point will be the point of cut-off, and since the distance between the point k and 19 is about $\frac{1}{8}$ of the space from 19 to 20, we conclude that the piston has traveled $19\frac{1}{8}$ inches from the beginning of its stroke when the admission of steam into the cylinder is suppressed.

Here we see that when a valve has no lead, as in Fig 55, the admission of steam into the cylinder will cease when the piston has traveled 20 inches; and when the angular advance of the eccentric is changed, as in Fig. 56, so that the valve has $\frac{1}{4}$ of an inch lead, the point of cut-off will be at $19\frac{1}{8}$ inches from the beginning of the stroke, a difference of $\frac{7}{8}$ of an inch between the point of cut-off in Fig. 55 and that in Fig. 56. But the lead in locomotive valves in full gear is only about $\frac{1}{32}$ of an inch, which will affect the point of cut-off so very little that we need not notice its effect upon the period of admission, and, therefore, lead will not be taken into consideration in the following examples.

THE TRAVEL OF THE VALVE WILL AFFECT THE POINT OF CUT-OFF.

Fig. 57 represents the same valve and ports as shown in Fig. 55, but the travel of the valve in Fig. 57 has been increased to $5\frac{3}{4}$ inches. The point of cut-off k has been obtained by the same method as that employed in Figs. 55 and 56, and we find that this point k coincides with point 21. Now, notice the change caused by an increase of travel; when the travel of the valve is 5 inches, as shown in Fig. 55, the admission of steam into the cylinder will cease when the piston has traveled 20 inches from the commencement of its stroke, and when the travel of the same valve is increased $\frac{3}{4}$ of an inch, as shown in Fig. 57, the admission of the steam will not be suppressed until the piston has traveled 21 inches. Here we notice a difference of 1 inch between the two points of cut-off. But it must be remembered that when the travel of a valve for a new engine is to be found or established, the point of cut-off does not enter the question; we simply assign such a travel to the valve that steam ports will be fully opened, or slightly more, when the valve is in full gear; and how to find this travel has been explained in a previous paper. The point of cut-off is regulated by the lap and position of the eccentric.

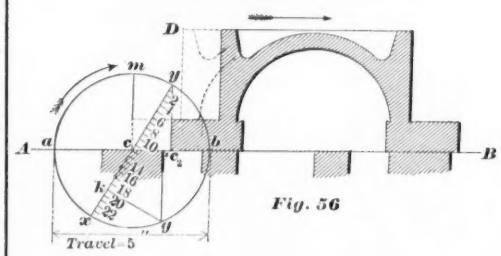


Fig. 56

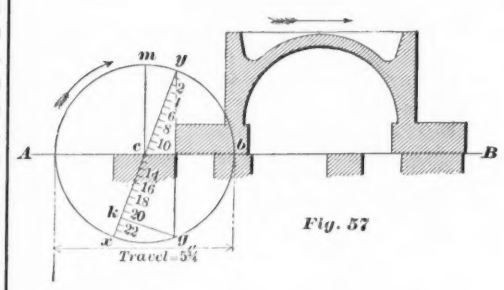


Fig. 57

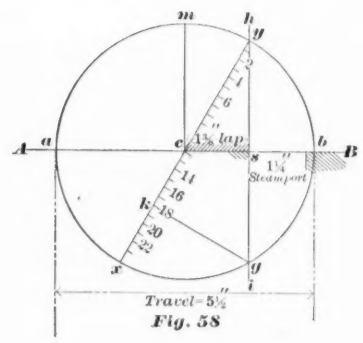


Fig. 58

In order to find the point of cut-off it is not necessary to make a drawing of the valve, as has been done in Fig. 55. The only reason for doing so was to present the method of finding the point of cut-off to the beginner in as plain a manner as possible. In order to show how such problems can be solved without the section of the valve, and, consequently, with less labor, another example, similar to Example 18, is introduced.

Example 20.—Lap of valve is $1\frac{3}{8}$ inches; travel, $5\frac{1}{2}$ inches; stroke of piston, 24 inches; width of steam port, $1\frac{1}{4}$ inch; find the point of cut-off.

Fig. 58. Draw any straight line, as $A\ B$; anywhere on this line mark off $1\frac{1}{4}$ inch, equal to the width of the steam port. From the edge s of the steam port lay off on the line $A\ B$ a point c the distance between the points s and c being $1\frac{3}{8}$ inches; that is, equal to the amount of lap. From c as a center, and with a radius equal to half the travel, namely, $2\frac{3}{4}$ inches, draw a circle $a\ b\ m$; the circumference of this circle will represent the path of the center of the eccentric, and also that of the crank-pin. Through s draw a straight line $i\ h$ perpendicular to $A\ B$, this line $i\ h$ will intersect the circumference $a\ b\ m$ in the points y and g. Through the points y and c draw a straight line $y\ x$; the diameter $y\ x$ will represent the stroke of the piston. Divide $y\ x$ into 24 equal parts; through the point g draw a straight line $g\ k$ perpendicular to $y\ x$, and intersecting $y\ x$ in the point k, and this point is the point of cut-off. Since k coincides with the point 18, it follows that the piston had traveled 18 inches from the beginning of its stroke when the flow of the steam into the cylinder ceased.

Now, we may reverse the order of this construction and thus find the amount of lap required to cut off steam at a given portion of the stroke.

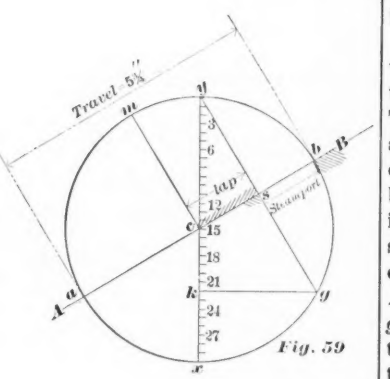


Fig. 59

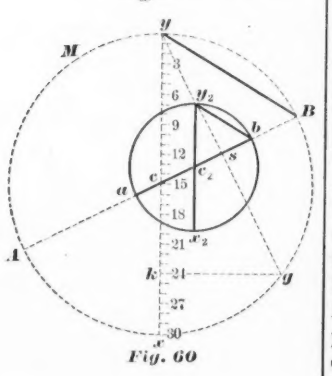


Fig. 60

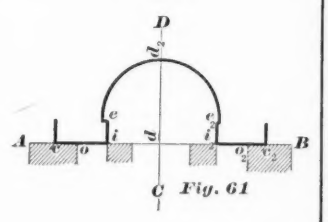


Fig. 61

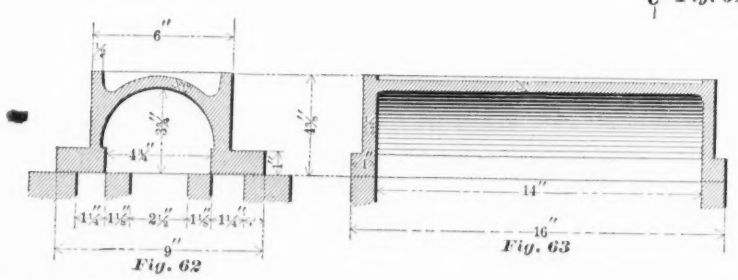


Fig. 62 Fig. 63

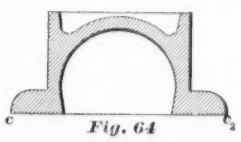


Fig. 64

Example 21.—Travel of valve is $5\frac{3}{4}$ inches; stroke of piston, 30 inches; steam to be cut off when the piston has traveled 22 inches from the beginning of the stroke; width of steam port, $1\frac{3}{8}$ inch; find the lap.

Fig. 59. Draw a circle $a\ b\ m$ whose diameter is equal to the travel of the valve, viz., $5\frac{3}{4}$ inches. Through the center c draw the diameter $y\ x$. In this figure we have drawn the line $y\ x$ vertically, which was done for the sake of convenience; any other position for this line will answer the purpose equally well. The circumference $a\ b\ m$ represents the path of the center of the eccentric, also that of the crank-pin; the diameter $y\ x$ will represent the stroke of the piston, and, therefore, is divided into 30 equal parts. The steam is to be cut-off when the piston has traveled 22 inches from the beginning of the stroke, therefore through the point 22 draw a straight line $g\ k$ perpendicular to $y\ x$, the line $g\ k$ intersecting the circumference $a\ b\ m$ in the point g. Join the points y and g by a straight line. Find the center s of the line $y\ g$, and through s and perpendicular to the line $y\ g$, draw the line $A\ B$; if the latter line is drawn accurately it will always pass through the center c. The distance between the points s and c will be the amount of lap required, and in this example it is $1\frac{7}{16}$ inch.

It sometimes occurs, in designing a new locomotive, and often in designing stationary or marine engines, that only the width of steam port and point of cut-off is known, and the lap and travel of the valve is not know. In such cases both of these can be at once determined by the following method:

Example 22.—The width of the steam port is 2 inches; the stroke of piston, 30 inches; steam to be cut-off when the piston has traveled 24 inches from the beginning of its stroke; find the lap and travel of the valve.

Fig. 60. Draw any circle, as $A\ B\ M$, whose diameter is larger than what the travel of the valve is expected to be. Through the center c draw the diameter $y\ x$, and, since the stroke of piston is 30 inches, divide $y\ x$ into 30 equal parts. Steam is to be cut off when the piston has traveled 24 inches; therefore through point 24 draw a straight line $g\ k$ perpendicular to the diameter $y\ x$, intersecting the circumference $A\ B\ M$ in the point g. Join the points y and g by a straight line; through the center s of the line $y\ g$ draw a line $A\ B$ perpendicular to $y\ g$. So far, this construction is precisely similar to that shown in Fig. 59, and in order to distinguish this part of the construction from that which is to follow, we have used dotted lines; for the rest full lines will be used. It will also be noticed by comparing Fig. 60 with Fig. 59 that, if the diameter $A\ B$ had been the correct travel of valve, then $c\ s$ would have been the correct amount of lap. But we commenced this construction with a travel that we know to be too long; hence, to find the correct travel and lap, we must proceed as follows: Join the points B and y. From s, towards B, lay off on the line $A\ B$ a point b; the distance between the points s and b must be equal to the width of the steam port plus the amount that the valve is to travel beyond the steam port, which, in this example, is assumed to be $\frac{1}{8}$ of an inch. Therefore the distance from s to b must be $2\frac{1}{8}$ inches. Through b draw a straight line $b\ y_2$ parallel to $B\ y$, intersecting the line $y\ g$ in the point y_2. Through the point y_2 draw a straight line $y_2\ x_2$ parallel to the line $y\ x$, and intersecting the line $A\ B$ in the point c_2. From c_2 as a center, and with a radius equal to $c_2\ b$, or $c_2\ y_2$, describe a circle $a\ b\ y_2$. Then $a\ b$ will be the travel of the valve, which, in this case, is $7\frac{5}{8}$ inches, and the distance from c_2 to s will be the lap, which, in this example, is $1\frac{11}{16}$ inch.

PRACTICAL CONTRUCTION OF THE SLIDE-VALVE.

It should be obvious, and, therefore, almost needless to remark here, that the foregoing graphical methods employed in the solutions of the problems relating to the slide-valve are applicable to every-day practice. the writer believes that these methods are the simplest and best to adopt for ordinary use, and without these it would be difficult to construct a valve capable of performing the duty assigned to it. Of course, when a graphical method is employed, great accuracy in drawing the lines is necessary.

We will give a practical example, in which one of the objects aimed at, is to show the application of one of the forgoing methods to ordinary practice.

Example 23.—The width of the steam ports is $1\frac{1}{4}$ inch; length of the same 14 inches, thickness of bridges $1\frac{1}{8}$ inch; width of exhaust port $2\frac{1}{2}$ inches; travel of valve $4\frac{3}{4}$ inches; stroke 24 inches; steam to be cut-off when the piston has traveled $20\frac{3}{4}$ inches from the beginning of its stroke; the edges of the exhaust cavity are to cover the steam ports, and not more, when the valve stands in a central position; construct the valve.

Fig. 61. Draw a straight line $A\ B$ to represent the valve-seat through any point in $A\ B$; draw another line $D\ C$ perpendicular to $A\ B$; the line $D\ C$ is to represent the

center of exhaust port and the center of valve. Draw the exhaust port, bridges and steam ports as shown.

The question now arises: How long shall we make the valve? Or, in other words, what shall be the distance between the outside edges of the valve c and c_2? If the valve had to admit steam during the whole stroke of the piston, or as the practical man would say, "follow full stroke," then the distance between the edges c and c_2 would be equal to the sum of twice the width of one steam port plus twice the width of one bridge plus the width of the exhaust port, hence we would have $2\frac{1}{2} + 2\frac{1}{4} + 2\frac{1}{2} = 7\frac{1}{4}$ inches for the length of the valve. But, according to the conditions given in the example, the valve must cut-off steam when the piston has traveled $20\frac{3}{4}$ inches, therefore the valve must have lap, and the amount of lap that is necessary for this purpose must be determined by the method shown in Fig. 59, and given in connection with Example 21. Following this method, we find that the required lap is $\frac{7}{8}$ of an inch, therefore the total length of the valve will be $7\frac{1}{4} + (\frac{7}{8} \times 2) = 9$ inches: or, we may say, that the distance between the edges c and c_2 must be equal to twice the width of one steam port plus twice the width of one bridge plus the width of the exhaust port plus twice the lap, consequently we have $2\frac{1}{2}+2\frac{1}{4}+2\frac{1}{2}+1\frac{3}{4}=9$ inches for the length of the valve. Through the points c and c_2 (each point being placed $4\frac{1}{2}$ inches from the center line $C\ D$), draw lines perpendicular to $A\ B$; these lines will represent the outside surfaces containing the edges c and c_2. These surfaces must be square with the surface $A\ B$, because, if they are not so, but are such as shown in Fig. 64, the distance between the edges c and c_2 will decrease as the valve wears, and when this occurs, the valve will not cut off the steam at the proper time. Now, in regard to the cavity of the valve. One of the conditions given in our example is, that the edges of the cavity must cover the steam ports, and no more, when the valve stands in a central position, therefore the inner edges i and i_2 of the valve must be $4\frac{3}{4}$ inches apart, which is equal to twice the width of one bridge plus the width of the exhaust port; consequently, when the valve stands midway of its travel, the inner edges of the valve (being $4\frac{3}{4}$ inches apart), the inner edges of the steam ports coincide. Through the points i and i_2 (each being placed $2\frac{3}{8}$ inches from the center line $C\ D$), draw the straight lines $i\ e$ and $i_2\ e_2$ perpendicular to $A\ B$. These lines will represent the sides of the cavity containing the inner edges i and i_2 of the valve, and these sides must be square with the surface $A\ B$; if these are otherwise, for instance, such as shown in Fig. 64, the distance between the edges i and i_2 will change as the valve wears, and then the valve will not perform its duty correctly. The depth $d\ d_2$ of the cavity is generally made from $1\frac{1}{4}$ to $1\frac{1}{2}$ times the width of the exhaust port. The writer believes that making the depth of the cavity $1\frac{1}{2}$ times the width of the exhaust port is the best practice. In our example the width of the exhaust port is $2\frac{1}{2}$ inches, and $2\frac{1}{2}+1\frac{1}{2}=3\frac{3}{4}$ inches, which will be the distance from d to d_2, that is, the depth of the cavity. The curved surface of the cavity is generally a cylindrical surface, and when it is so, as in our example, this surface must be represented in Fig. 61 by an arc of a circle. The sides $i\ e$ and $i_2\ e_2$ must be planed, and to do this conveniently, these sides must extend a a little beyond the curved surface, toward the center $C\ D$. Consequently, through the point d_2 draw an arc whose center is in the line $C\ D$, and whose radius is such that will allow the sides to project about $\frac{1}{16}$ of an inch. Here, then, we have lines which completely represent the cavity of the valve and the valve face. If we now add to these lines the proper thickness of metal as shown in Fig. 62, this section of the valve will be complete.

Fig. 63 shows a section of the valve taken at right angles to that shown in Fig. 62. Since the ports are 14 inches long the cavity of the valve must be 14 inches wide, as shown. The amount that the valve overlaps the ends of the steam ports must be sufficient to prevent leakage. For a valve of the size here shown, 1 inch overlap is allowed. and the thickness of metal around the cavity is generally one-half of an inch. For smaller valves the overlap at each end of the steam port is from $\frac{3}{4}$ to $\frac{7}{8}$ of an inch, and the thickness of metal around the cavity is $\frac{3}{8}$ of an inch.

The valve here shown is suitable for a locomotive cylinder 16 inches in diameter, and a piston speed of 525 feet per minute, and the dimensions here given agree with those of the valves that are at present in use.

LETTERS FROM PRACTICAL MEN.

Fitting Keys.

Editor American Machinist:

Some remarks by two or three of your correspondents bring to my mind the almost constant wonder why the holes of pieces to be fitted comparatively loosely to shafts, and keyed, are not chambered. I have in machine shop practice for twenty years, made a practice of chambering the bore of all pieces of this kind, unless there were special reasons for not doing so. What I mean by chambering, is not necessarily casting a chamber, but slightly enlarging the bore so as to leave a bearing at the ends of the hub only. If such a hole does not fit the shaft closely, it will be a poorly fitted key that will throw the piece out sideways.

Perhaps if I *manufactured* such pieces I should object to the expense of chambering, but I imagine I should invent an attachment to my boring arrangement, whatever it was, that would do the work without much expense.

In fitting keys that must fill top and bottom, which my experience is all keys must do, unless the piece to be keyed is a force fit, I have always had the habit of easing off the fit a little at each end of the key, so that in the hub of the piece being keyed the key should fit hardest at the center of its length; this I have found would go a long way in avoiding the danger of throwing a piece out sideways that was not chambered in the bore.—GLEASON.

Formula for Linear Advance of Eccentric with Rocker Arms of Unequal Length.

Editor American Machinist:

The following simple formula may be of interest:

Let L = Lap of valve.
Let E = Throw of eccentrics.
Let T = Travel of valve.
Let X = Linear advance of eccentrics.

$$\text{Then } X = \frac{LE}{T}$$

EXAMPLE:

Lap of valve .625″.
Throw of eccentrics 4″.
Travel of valve 5″.
Then .625″ × 4″ = 2 50. ÷ 5.″ = .5″
= linear advance of eccentrics.

Travel of valve is found by dividing the difference in length of rocker arms by 2, adding throw of eccentrics.

EXAMPLE:

Lower arm 8″, upper arm 10″.
Throw of eccentrics, as above, 4″.
Then 10″ — 8″ = 2″ ÷ 2 = 1 + 4 = 5″
= travel of valve.

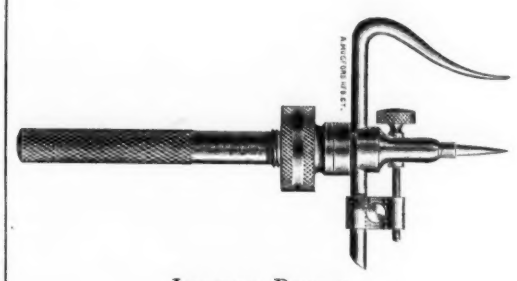
The above is applicable where the upper arm is the longer, which is the usual practice. RALPH E. STATE.

Economy in the Use of Fuel.

Editor American Machinist:

In your issue of October 24th "Fair Play" invites any one who can do better in economy of fuel to let it be known. I think we can go him one better. We are running 130 feet of line shafting, one blower, one tumbler for foundry, one punch and shear, one drill for boiler shop, two blowers for forges, one 24″ planer, one 12″ shaper, one 20″ drill press, two small drills, three engine lathes—one 20″, one 17″, one 15″—three speed lathes, one wood lathe, one fox-turret lathe and two buffing spindles for brass finishing, two emery grinders and one grindstone.

Our boiler is an upright, without jacket; engine is automatic, 8″×9″ cylinder, balanced valve. Have been very busy since April 1st, and from that time to date it has cost us only 27 cents per day for fuel. We use culm, which costs us $1.40 per ton. To get up steam we use shavings, and coal which we screen from the culm. Boiler is upright, without jacket, $4\frac{1}{2}'$ grate and 120′ heating surface. A pump supplies boiler with water, heated by exhaust steam; speed, 120 revolu'ions per minute. KNAPP & SON.
Binghamton, N. Y.



IMPROVED DIVIDER.

Automatic Drill Ratchet.

Editor American Machinist:

The last item in the first column of AMERICAN MACHINIST, Oct. 3, speaks of an automatic feed rachet, by which "the drill is moved in the right direction for cutting by both the forward and backward motion of the lever or handle." This drill stock was, it stated, exhibited at the Inventors' Exhibition, England.

This tool will prove useful if it can be made as durable as the ordinary ratchet, but it is not new, at least in America. In 1869 a ratchet drill stock was patented, made and sold by a party whose name I have forgotten, in the city of Worcester, Mass. This drill would not only work during both strokes, but also during an up or down stroke, and the same with an angular motion of the handle or lever.

In fact, any motion whatever, if imparted to the lever, would cause the drill to cut.

The device consisted of three miter gears, one of which was fixed upon the drill socket, the other two carried rachets, one of which engaged the lever when motion was imparted to it in any direction.

For some reason, probably "structural weakness," the device never came into extensive use, although many are used and work well. JAMES F. HOBART.

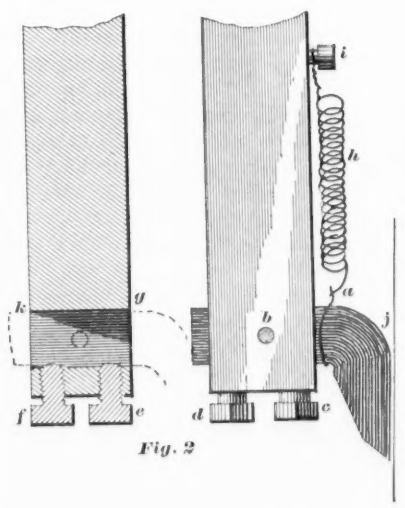


Fig. 2

President Barnett, of the Railway Master Mechanics' Association, has appointed the following committees to report upon the subjects named at the next Convention, at Boston, in June, 1886:

Improvement in Boiler Construction—Geo. W. Stevens, Wm. Fuller, T. J. Hatswell.

Standard Driving-Wheel Centers and Standard Section of Tire—J. N. Lauder, Jacob Johann, H. N. Sprague.

Driving-Wheel Brakes: To what extent is their use advisable, and Best Method of Application—J. Davis Barnett, H. A. Whitney, F. M. Wilder.

Balance Slide Valves—Charles Blackwell, James Meehan, E. M. Roberts.

Best Material and Form of Construction for Locomotive Guides and Crossheads—A. J. Cromwell, William Swanston, A. Beckert.

Best Plan for Removing, Cleaning and Re-setting Flues—Clem. Hackney, A. W. Sullivan, G. H. Prescott.

Shop Tools and Machinery—D. A. Wightman, A. J. Pitkin, F. B. Miles.

Hammer-Blow Tests of Locomotives—William Woodcock, Thos. L. Chapman, Coleman Sellers, Angus Sinclair, F. W. Dean.

Papers to be read by two Associate Members, viz.—Robert Grimshaw, John A. Coleman.

Boston Fund, Printing and General Supervisory Committee—J. D. Barnett, William Woodcock, Jacob Johann, Geo. Richards, J. H. Setchel.

Standing Committee on Subjects—James M. Boon, T. B. Twombly, Charles Blackwell.

Committee of Arrangements for Nineteenth Annual Meeting—J. N. Lauder, Geo. Richards, H. L. Leach.

Shop Notes.

SLOTTING TOOL AND BAR.

Fig. 2 shows a tool for a slotter. The bar of steel has a stop cut through it to receive the tools; c and d are two set-screws. Their use is shown in the section. The left-hand screw is adjusted to touch the cutter, and prevent the pin b from being sheared by power absorbed during the cutting stroke. When the cutter is returning, or during the up strokes, it yields at k owing to being cut away as shown in the section, and the point of the tool is not damaged. When it gets up through the work, a spring h pulls it back into cutting position. All the strain that has to be borne by the pin b is the horizontal thrust of the cutter, and this, owing to its cramping at g and f, the pin is well able to stand.

The cutters may be changed instantly from finishing to roughing, by slipping out the pin b, putting the new cutter through the spring loop a, and replacing the pin. The tool bar itself, may remain undisturbed.

Dropping a "plumb line," is one of the things that is not always done right.

How would it work if we desired to mark several points on a floor directly beneath a line stretched between targets.

Sam hangs his plumb line near to the given line and keeps moving it up closer and closer until it touches. Then, he goes below and makes his mark. At the next place he may bear up a trifle after the two lines have come in contact. At the third place, the lines may barely touch and so the three points on the floor are visibly out of line.

Don't do that way. Bring the plumb line up within a certain distance of the given line. Guess at this distance, either with your eye, or a micrometer caliper. At the second point, bring the plumb to the same distance, and do the same at the third and all other points.

Don't try any contact business, and then call it "within a hair." One of my hairs calipers $\frac{4}{1000}''$, and they say a "red hair" is as big as a blacksmith's $\frac{1}{8}''$.

The chap who drops his lines by the "contact" plan, will be as bad off as John Ingalls, the carpenter. When he ran a rip saw he wanted $\frac{7}{8}''$ of stock to "go and come on" for "rambling wood."

The same chap gets left every time he tries to "work to a line." Bye-and-bye he will give it up and try to work up to within a certain distance of that line, and then he will hit it, every time.

Improved Divider.

We illustrated this tool in our issue of Dec. 6, 1884, as it was then made. Our present illustration represents a decided improvement recently made. The improvement consists of applying the small milled head-screw shown; by the use of this, minute adjustment can be made, adapted for the finest work. This divider does not crowd over the center, in use, and has large range of sizes. It is made by the Hartford Tool Co., Hartford, Conn.

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NEW YORK, NOVEMBER 21, 1885.

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A Reason Why Boilers Explode.

Notwithstanding all the progress of modern mechanical science and steam engineering the number of disastrous boiler explosions seems to be increasing every year. We are told by certain philosophers, in the mechanical line, that these disasters are caused mainly by carelessness in managing the boilers, growing out of the ignorance of the parties owning them. No doubt this is the cause of many explosions, but it is even doubtful if it is the chief cause of such disasters. The buyers of boilers comprise parties in so many different pursuits that it is impossible with all the spread of mechanical knowledge that a large part of them should not be dependent upon others for ordinary mechanical information. These parties are not likely to apply to a disinterested mechanical engineer for advice, especially if there is a fee to be paid, and nine times out of ten they accept the dictum of the boiler maker as conclusive. If the boiler maker is thoroughly conscientious and prizes his reputation as well as the profit to be made on the contract, his advice will be safe to follow, but such is not always the case. A safe and reliable boiler will cost more than one built of poor material and slighted in workmanship. The latter appears about as well to the inexperienced buyer, and the difference in price, backed with some persuasion on the part of the maker, often determines the sale. These are the boilers that do most of the blowing up, and most of the destruction to life and property, and the *men that build them know their liability to disaster.*

It is an interesting study to examine the record of boilers sent out from different shops. Some shops there are with a record of hundreds, even thousands of boilers made and sold without a single explosion being heard of among the whole number. Others with a large production extending over many years can discover but one or two cases of explosion. Again we find boiler making establishments that have been quite frequently brought to public attention through disasters to boilers of their manufacture. It is impossible to believe that all the boilers from one builder go into competent and careful hands, while a large part of those from another shop in the same section of the country go into charge of careless and incompetent engineers. It is not mere chance that causes boilers from certain shops to explode, while those from certain other shops remain in service without disaster.

It is a usual thing when a boiler blows up, to try and fasten the blame upon the engineer or fireman. Failing in this, the proprietor is generally charged with the whole responsibility. The maker of the boiler is the last person thought of for censure, and in most cases goes scott free, even though the boiler was never a safe or strong one.

The maker of inferior boilers, at low prices, is likely to excuse himself on the ground that he supplies a definite demand that could not be met with safe boilers at higher prices, and that if he does not supply that demand others will do it. This is equal to the logic of the footpad who relieves the traveler of his valuables because another thief is lying in wait for him. If the traveler is certain to be robbed, he would be no poorer than if plundered by the second thief, hence the first one quiets his conscience by the thought that he is causing no extra distress.

The average grade of engineers, who handle steam machinery, is being elevated every year, but we doubt very much if the average grade of steam boilers is being elevated in the same proportion. There is room for decided improvement in many boiler shops.

A young man in Connecticut asks us for information regarding the "bulls" of Wall street, who hoist up what they call "prices" of stocks and bonds, and the "bears" whose aim and delight it is to paw prices down. While it does not lie within our province to give attention to subjects of this sort, we cannot refrain from suggesting to our correspondent, that his case appears to exemplify the wisdom of the poet's remark: "Where ignorance is bliss, 'tis folly to be wise." Except to the limited extent to which their services are required in handling investment securities, both bulls and bears represent merely gambling. In dealing with the speculative elements behind them, our correspondent, if he meddles, will find himself playing against loaded dice. He will find himself, an outsider, trying to cope with insiders, who allow no information to escape, relating to the properties whose securities are gambled in, until they have made themselves secure. We advise our correspondent to devote his attention to the legitimate, and to let Wall street and other gamblers severely alone.

Inducements to Manufacturers.

We called attention editorially last week to the conflicting views of the tax payers in a manufacturing city as to the best plans for inducing manufacturers to locate. The problem is not easy of solution; we notice that just now it is disturbing the peace of several towns and cities. In a case where there is no manufacturing the same objections are not likely to be raised as where there is already considerable; every one is likely to look upon it as an advantage. But when there are already others, particularly in the same line, the case is different. A machinist, for instance, struggling hard to build up a business, doing some manufacturing but depending largely upon local custom, may, with considerable reason, object to paying part of the taxes of a rival to build up an opposition to himself. But he will not object to helping along some other enterprise that will be likely to bring him more work. He would like to see another mill going up, but the other miller objects.

Altogether it is a vexed question, and it is not surprising that a good deal of opposition to the plan of abating taxes and donating land is being developed. There is one plan against which no objections are likely to be raised, and which will work injustice to none. That is to so manage affairs that taxes will not be burdensome; that the location will be a good one for manufacturers, so good that they will be willing to pay their just share of taxes. Not unfrequently it is found that when extra inducements are held out local mismanagement has made tax rates so high that something of the kind must be done to attract capital. But it will be more likely to be attracted by a return to honest economical administration of public matters. Manufacturers are likely to reason ahead to the time when they must pay taxes on their investment—and locate elsewhere than where taxes are abnormally high. In many cities tax rates are well up towards what would be a fair profit on investment, and the tendency to increase seems to be growing. This not only prevents manufacturers from locating, but it drives away those already located. With honest business-like expenditures of public money there will be little need of offering special inducements, and such inducements will have but little weight in bringing about removal of established enterprises.

Defects at the American Institute Fair that Should be Remedied.

There are two things at the Fair of the American Institute, in this city, that the management should remedy. One of these is the leaky roof over the department devoted to machinery. As one exhibitor of valuable machinery expressed it: "When it rains, it reminds one of the Fire Department out on a holiday." Manufacturers are justly displeased with putting machinery in position when to keep it reasonably dry it would be necessary to erect a tent over it.

Another thing that should be remedied is the condition of the floor on which much of the machinery stands. Taking hold of the top of one of the machines in operation, it was found that a slight pressure was sufficient to move it through several degrees from the springing of the floor. Exhibitors should not be required to place costly machines where they are liable to be ruined from lack of anything reasonably stable to rest upon. As one of the most important attractions of the fair is machinery in motion, the management owe it to exhibitors to remedy this defect, otherwise they will find the number of those who are willing to show machines at work growing less; in fact, but for this defect, it is probable that there would be much more machinery in operation than there is.

Dangers of the Cable System.

A recent mishap that occurred to one of the cars of the Philadelphia Traction Co. illustrates the dangers attending cable transit according to the system there used.

One of the "grips" became entangled, the grip-man was unable to release it, and the result was that the motor, to which the grip was attached, came in collision with a transfer car drawn by horses, which passes over a part of the cable road between Fortieth and Forty-first streets on Market, and seriously injured four persons, besides killing the two horses attached to the transfer car, and damaging a number of motor cars as well as the transfer car.

The accident caused a detention of nearly two hours to the regular traffic on the road, due to the time consumed in getting horses distributed over the line to bring in the cars.

The Naval Board, appointed to examine the work done by John Roach on the cruisers Chicago, Boston and Atlanta, has rendered a report, which was approved by Secretary Whitney. The work done by Mr. Roach was reported good, and he will be paid for what has been done, the Government completing the vessels.

We learn that the use of electric headlights on the railway between St. Petersburg and Moscow has been abandoned, for the reason that they were ruining the eyesight of engineers and firemen. It is now proposed to light the entire line by electric-lights at regular intervals.

Literary Notes.

A TEXT-BOOK OF THE MATERIALS OF CONSTRUCTION, for use in Technical and Engineering Schools. Abridged from "Materials of Construction." By Robert H. Thurston, M. A., Doc. Eng., Professor of Mechanical Engineering and Director of Sibley College, Cornell University; past President American Society of Mechanical Engineers, Member of American Society Civil Engineers, etc., etc. New York: John Wiley & Sons, 15 Astor place.

As indicated in the title, this book is made up from the three volumes previously published. The matter is somewhat differently arranged, and is brought, in a single volume, into such shape as to be more available, not only in the class-rooms of technical schools, but it will, in many instances, be preferred by the engineer in practice, as being more portable. It is a very complete work, treating of the qualities and manufacture of metals and alloys, strength and uses of timber, stones and cements, etc. Those who do not have the three volumes referred to would, we should think, want this book. The price is $5.

ARCHITECTURAL STUDIES. Part II. Store Fronts and Interior Details. Edited by F. A. Wright, Architect. New York: William T. Comstock, 6 Astor place.

Part II. of this work contains twelve large plates of store fronts and interior details, with descriptive text. It is a work of undoubted value to those engaged in architecture or building. The price is $1.

Effects of Over Capitalization on American Manufactures.

Whether business is good or bad in this country, there are not wanting exponents of all sorts of plans for making it better. But with all the consideration given to this class of subjects by either our people or our legislators, few seem to have realized the full disadvantage under which American manufactures labor, owing to the system of over-capitalization prevailing in so branches of corporate enterprise.

The operations of most of the iron mines which produce the ore upon which the iron-working processes are based, and of the coal "combinations" which furnish the fuel used in these and all other branches of productive industry forcibly illustrate, in the main, the attempt to pay dividends on largely watered stock. The railroads which do the carrying trade of the country, almost without exception, are not only over-capitalized, but are heavily over-bonded, as well, being mainly built and equipped from the proceeds of bonds issued at heavy discount, the stock being usually turned in to the same parties without substantial consideration.

A logical result of this condition of things in American railways, is a chronic system of overcharging, alternating with those frequent fluctuations of rates due to over-competition which tend to visibly demoralize all business. As a rule, railroad wars are about as injurious to business interests as the condition of inflated charges which causes them. When the vast extent of the railroad mileage of the country is taken into the account, the evil effect of the conditions there so largely prevalent can hardly be overestimated.

But the practice of over-capitalization is not confined within even the enormous limits already mentioned. The examples which we have cited by way of illustration, can be almost indefinitely added to by every reader. The names of steamship companies, telegraph companies, telephone companies, gas companies and some manufacturing companies readily suggest themselves to the imagination.

We are glad to note, however, that the machine trade, as such, stands in a more wholesome attitude upon this question than most branches of business liable to require corporate organization. It is true that "companies" are being organized continually on the "million" plan, for the purpose of exploiting some bogus boiler, engine, or other contrivance for the evolution of something out of nothing, but such concerns cannot be said to represent anything in the way of legitimate business in the machine trade. Their existence is only a symptom of the disease prevailing elsewhere.

Many steps are urged as necessary to enable American manufacturers to compete with foreign nations. It is doubtful, however, whether anything that has yet been urged, would so greatly aid our people in efforts to extend our trade, both foreign and domestic, as the ability to start square, from a level basis, as to capital, eliminating fictitious values and the disturbances which follow in their train.

As to the remedy for the existing difficulties, it will not be an easy one. Most likely it will be largely confined, of necessity to attempting to limit them for the future, leaving the country and its business to grow up to the basis imposed by the existing situation.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(322) **C. S. R., Plattsburgh, N. Y., asks:** What is a good black paint for smoke-stack? *A.*—Dissolve asphaltum in turpentine at a gentle heat.

(323) **J. H. L., Newton, Mass., asks:** What is the best material to use for a roll 24" long, of different diameters up to 13¼", and what is the best method of case-hardening? *A.*—We do not know of anything that will case-harden better than best quality of homogeneous wrought iron, and no method better than heating in a closed box with animal charcoal. You cannot harden such a roll without springing.

(324) **C. L. A, Malden, Mass., asks:** Will you give me a cement for leather, also for rubber belts, to resist moisture? *A.*—A cement for leather belts that is recommended is: Dissolve gutta-percha in bi-sulphide of carbon to the consistency of molasses; warm the parts and unite by pressure. For rubber: Take 16 parts gutta-percha, 4 parts india-rubber, 2 parts common caulker's pitch, and 1 part linseed oil. Melt together and use hot.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

T. M. Parker, Steel Stamps, Stencils, Hart'f'd, Ct.

J. Clayton, Air Compressors, Rock Drills. 43 Dey st, N Y

Edw. Sears, wood engraver, 48 Beekman st., N.Y.

Steel Name Stamps, &c. J.B. Roney, Lynn, Mass.

Tack, Wire, and Shoe Nail Machinery; Wm. A. Sweetser, Brockton, Mass.

Tack and Wire Nail Machinery, made by the Willets Mfg. Co., Providence, R. I.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

Patent attorney and expert. Machine designs and details. Wm. H Weightman, 82 Astor House, N.Y.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn

Foot-Power Machinery for workshop use, sent on trial if desired. W. F. & Jno. Barnes, Rockford, Ill.

Lyman's Gear Chart. How to lay out gear teeth. Price, 50c. E. Lyman, C E., New Haven, Conn.

Machines to form and bend steel and iron; run by power. Williams, White & Co., Moline, Ill.

Improved Labor-Saving Upright Drills. 20 in. to 36 in. inclusive. Currier & Snyder, Worcester, Mass.

Roper's Engineers' Handy Book, $3 post paid. Theo. Audel & Co., Booksellers, 32 Liberty st., N.Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham st., N. Y.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See Nov 7 p. 14. Send for circular No. 17, Curtis Reg Co., Boston, Mass.

Files recut without drawing temper, about one-half usual prices; samples recut free; prices on application. The Acme Co, Collinsville, Conn.

The outline ("wax process") engravings shown in the AM. MACHINIST each week are made by Struthers, Servoss & Co., 24 to 34 New Chambers St., N.Y.

"Complete Practical Machinist," $2.50; "Mechanical Drawing Self-Taught;" $4. Books for workmen. Joshua Rose, Box 3306, New York City.

Kellam's Pressure Regulator—used in heating system of 11-story building, Madison ave., N. Y.,—saved, last season, $2,000 over previous season. Hine & Robertson, 12 Cortlandt street, New York.

CORLISS ENGINE DRAWINGS FOR SALE, either Blue Prints or Tracings, with all latest improvements, all sizes. Fred. A. Phelps, Engineering Office, Room 5, 445 Broad st., Newark, N.J.

Locomotive Engine Running and Management. By Angus Sinclair. Gives full directions about handling and repairing locomotives; instructs how to design valve gear and set valves; Westinghouse air brake explained by aid of engravings. Price, $2. For sale by *National Car Builder*, 187 Dearborn st., Chicago, Ill.

Every young man who aspires to be either a mechanic, merchant, or manufacturer, owes it to himself that he become thoroughly familiar with the writings of Chordal. John Wiley & Sons, 15 Astor Place, N. Y., have issued a new and enlarged 12 mo edition of "Extracts from Chordal's Letters." Handsomely bound in cloth, with over 50 illustrations. Price, $2. Discount of 25 per cent. on orders for five or more copies.

MANUFACTURES.

Vicksburg, Miss., is in the field for water-works.

Wellsboro, Pa., has decided to have water-works.

J. C. Peck, Atlanta, Ga., will build a planing mill.

Jos. Bruening and others in Pittsburgh, Pa., will erect a large brewery.

A bridge is to be built over the Detroit river at Detroit, Mich, to Belle Isle.

Buck & Wright will establish a new carriage factory at Baldwinsville, N. Y.

Some new machinery will be put into the Marion Machine Shops, Marion, S. C.

Arthur Patterson and others will establish a large wagon factory at Carthage, N. Y.

Henry Rines, Augusta, Me., will erect a carriage factory, 40x70, and two stories high.

The works of the Boston Rubber Shoe Company, at Malden, Mass., are to be enlarged.

The National Tube Works, of McKeesport, propose to erect six new puddling furnaces.

The Globe Knitting Co., of Amsterdam, will erect works for the manufacture of knit goods.

The East Buffalo Furniture Co. will erect works and begin the manufacture of fine furniture.

The citizens of Gladsden, Ala., are anxious for the establishment of a cotton seed oil mill.

The New Bedford (Mass.) Manufacturing Co. will double their capital stock and build a new mill.

The Mason & Hamlin Organ Company, of Cambridge, Mass., will build an addition to their factory.

The flouring mill of H. J. Allen & Bros., Texarkana, Ark, recently destroyed by fire, is to be rebuilt.

Machine works are being erected at Sanford, Florida, to be known as the Industrial Machine Works.

Some one ought to sell a pumping engine to Jersey City. It is needed, and no doubt will be contracted for.

The Nashua Iron & Steel Company, Nashua, N. H., is enlarging its buildings and will increase its facilities.

The Rochester & Pittsburgh Railroad has reorganized under the name of the Buffalo, Rochester & Pittsburgh Railroad.

Dick & Meyers, South Ninth & Fifth streets, Brooklyn, N. Y., will erect an 8-story brick sugar refinery to cost $30,000.

The manufacturers of Laconia, N. H., find their water-power giving out, and steam power is very generally being resorted to.

It is reported that the Hall Duplex Steam Pump Co., 91 Liberty street, New York City, are negotiating to erect works in Plainfield, N. J.

Carnegie Bros., & Co., of Pittsburgh, Pa., are contemplating the erection of large steel works to manufacture structural steel.

The R. D. Cole Manufacturing Co., of Newnan, Ga., are refitting their shops and putting new machinery into their boiler works.

R. C. Coleman, of Cleveland, Ohio, will build a large iron and steel rolling mill, to cost $100,000, at Pittsburgh, to be completed May 1, 1886.

Jas. Tucker & Co. will remove their shoe factory from Wellesley to Milford, Mass. A new factory will be built to employ 300 to 400 hands.

Jos. Walton & Co., of Pittsburgh, Pa., will build a railroad from West Elizabeth, on the Monongahela river, to their coal lands, about five miles.

The Board of Public Works of Jersey City, N. J., are to furnish the city of Bayonne with water, the water furnished to be measured by meters.

It is said that a new rolling mill for iron hoops will be started at Milton, Pa. Bernard Lanth, of Howard, Pa., will furnish his three high rolls.

The Hall Steam Pump Co., 91 Liberty street, New York, are considering the advisability of erecting new shops to manufacture their steam pumps.

Rush & Sprague, Leavenworth, Kansas, expect to rebuild their large flouring mill, recently destroyed by fire. The mill was one of the largest in the State.

The Bowering Soap Manufacturing Co., capital stock $25,000, has been organized at Seffner, Fla. A two-story factory, will, it is reported, be erected at once.

Stratton Brothers & Company are building a factory at Athol, Mass, for the manufacture of packing boxes. They will put in steam power and machinery.

The old Cummings mill in Oswego, N. Y., the property of the Macfarlane estate, is to be rebuilt for the manufacture of pails, etc., from paper, on a large scale.

The Abilene (Tex,) *Reporter* says: "Abilene needs a woolen mill, and a suitable location will be donated by our citizens to the man or company who will put up the mill.

The price of nails has gone up, and the nailers and feeders at the Brooks Iron Co.'s works, at Birdsboro, Pa., have had their wages advanced 10 per cent. It affects 225 men.

A new chair factory is building at West Pans, Me., which will be 100x38 feet, three stories high. It will be run by J. H. Barrows, of that place, and J. W. Kimball, of New York.

The Standard Charcoal Company, Centerville, Tenn, which manufactures alcohol from wood, is to erect an iron furnace, and use their surplus gas in the manufacture of pig iron.

Large canal repair shops are to be erected at Rochester, for the State of New York. The works are to be under the supervision of Superintendent of Public Works, James Shanahan, Albany.

The Lookout Rolling Mill Company, of Chattanooga, Tenn., will at once erect an extensive plant, to cost $75,000, for the manufacture of iron and steel. A. M. Johnston, Chattanooga, President.

Wilson & Snyder Manufacturing Company, of 52 Water street, Pittsburgh, Pa., are fitting up a new machine shop for manufacturing steam pumps, etc.; will need lathes, planers, and other machinery.

The Bates Mill Corporation, Lewiston, Me., will make various changes and improvements in their factories. They will add new looms and other machinery, and build an addition 200 feet long to their bleachery.

J. E. & A. E. Eastabrook are erecting a four-story brick machine shop at Worcester, Mass. The new building is an extension of their present shop, and is 50x150 feet. The three lower floors will be occupied by Prentice Brothers.

The Indianapolis Rolling Mill Co. will change their mill from rail-making to a merchant iron mill. About $200,000 additional capital will be put in, and 300 men employed. A new plant of machinery will be purchased.

Benjamin S. Middleton, of Knowlton, Pa, and others, contemplate engaging in the manufacture of cotton and woolen goods near Norristown, Pa., and will place 100 looms and four sets of cards in operation. Capital, $50,000.

The New Jersey Steel and Iron Company, Fred. J. Slade, Treasurer, Trenton, N. J., will change their machinery and erect new buildings for the manufacture of steel by a new improved process. Estimated outlay, $100,000.

The Case & Willard Co., Battle Creek, Mich., will double their present capacity to make traction engines and threshing machines. Eighty more men will be employed, a new building erected, and a lot of new iron-working and wood-working machinery added.

The Mechanics' Club, of Minneapolis, Minn, Room 24, Tribune Building, will be glad to receive from manufacturers catalogues of steam-engines, pumps, wood and iron-working machinery, etc. The same will be bound and preserved for reference in the club library.

Geo. A. Stuck, of the Enterprise Ice Co., Selma, Ala., writes us: "Work has been commenced on the water-works for this city. A company has been organized for an electric light plant, and stock is being rapidly taken. A new cotton seed oil mill is being talked of. You will see that we are not asleep yet.

According to the Springfield *Republican* there is likely to be considerable railroad building in Maine this year. It says: "Work will begin, probably, on the Lake Megantis or international line, a road will be built possibly from the junction of the Monson road to Skowhegan, and one from Milo Junction by way of Kanduskeag to Bangor.

H. B. Slate, for the past five years employed in the office of Dwight Slate, Hartford, Conn., has accepted a position placing him in charge of the office work connected with the business of W. P. Davis, North Bloomfield, N. Y. Mr. Davis will hereafter devote his whole personal attention to the details of manufacture of his drills and key-seaters.

The Benwood Iron Works, at Wheeling, W. Va., are pushing their new Bessemer plant to completion. They have contracted through Westinghouse, Church, Kerr & Co., of New York, for a pair of Reynolds blowing engines, built by E. P. Allis & Co., of Milwaukee. Steam cylinders 34"x60" and air cylinders 48"x60" to make from 40 to 60 revolutions per minute.

A corporation is being formed in Lewiston, Me., composed of leading business men of that city, including D. Cowan, the well-known woolen manufacturer, for the purchase of the Readfield woolen mill, which has been idle for several years. If the proposed bargain is consummated, the new corporation will make extensive improvements upon the mill add new machinery and operate it to its fullest capacity.

Bowker & Lundberg, malleable iron founders, of Worcester, Mass., have begun the manufacture of "Mitis" wrought-iron castings in this country. Mr. Ostberg, a Swedish engineer, whom we noticed in our issue of Oct. 3 as interested in the right to manufacture in this country, is at present with them. We published June 6 a paper read before the Iron and Steel Institute of London, giving an interesting description of the manufacture of Mitis castings.

The Falcon Iron and Nail Co., of Niles, Ohio, decided on the 16th ult. to erect a sheet mill adjoining their present mill in Niles. It will be what is known as a single-sheet mill, making the finer grades of sheet iron, with a capacity of 250 tons per month. On the 20th ult. the company awarded contracts. The Hamilton works of Wm. Tod & Co., of Youngstown, will furnish the engine, which will be of the Porter-Hamilton pattern, and the train of rolls. The mill is to be completed by January 1.—*Iron Trade Review.*

The Cincinnati *Commercial Gazette* contains an account of the Waldumer electric brake on the C. W. & B. R. R. The train consisted of three coaches, one private car and one baggage car. It says, on the Norwood grade the guests were landed and the train backed up three-quarters of a mile. It was then at full speed run down the grade, which is at this point 68 feet to the mile, and its speed is judged to have been 45 miles an hour, when General Manager Stewart signaled for the brakes. They were applied, and the stop made in about a train length and a-half—say about 700 feet. It was the most remarkable stop, experts said, they had ever seen, grade, speed and distance considered.

The firm of Miller & Hopkins has been formed by Theodore S. Miller, Geo. W. Hopkins and Elisha Hopkins, at 127 to 129 Horatio street, New York. They are engineers, machinists and boilermakers, and will build engines and boilers, giving special attention to marine work. They will also do repairs. The works occupy a space 100 feet square, and are well equipped to do heavy or light work. Mr. Geo. W. Hopkins has been in Mexico for fifteen years, and brings a large trade from that country. Mr. Elisha Hopkins has been connected with some of the prominent shops in this city. Mr. Miller is the business manager. Mr. Frank Ramsey, for 27 years foreman of the Delamater Iron Works boiler shop, holds a like position in this new establishment.

Cast-steel piston-heads are being put in some locomotives that are being built for the Missouri Pacific Railroad by the Baldwin Locomotive Works.

Machinists' Supplies and Iron.

NEW YORK, Nov. 5, 1885.

The condition of the supply and manufacturing business remains about the same as last reported.

Iron—In American pig sales are reducing accumulated stocks to some extent. There is yet no advance in prices, but lower bids are not entertained. No. 1 X Foundry is quoted at $18 to $18.50 for standard brands; No. 2 X Foundry, $16 to $16.50; Grey Forge, $14.00 to $15.50.

Scotch Pig—There is no activity in Scotch brands. We quote Coltness, $19.50 to $20; Glengarnock, $18 50 to $19; Gartsherrie, $19 to $19.50; Summerlee, $19 to $19.50; Eglinton, $17.50 to $18; Langloan, $19.50; Dalmellington, $18 to $18.25.

Copper—Dealers are making efforts to maintain prices, but they find but little demand. Lake has sold in small lots at 11c.; other brands, 10¼c. to 10½c.

Tin—Quotations from London are a little higher, but the demand is light. We quote Banca, 20¼c.; Straits and Malacca, 20.55c.

Spelter—Refined, 5¼c. to 6c.

Antimony—Hallett's, 8.50c.; Cookson's, 9⅝c., with sales at slightly lower figures.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Situation as foreman of machine shop; good references given. Address Buckeye, AM. MACHINIST.

Wanted—Situation as tool-dresser, by a first-class workman. Address Durability, Box 126, Utica, N.Y.

Wanted—By a young man, situation as foreman of machine shop, or to take work by contract. Address Tact, AM. MACHINIST.

A draftsman and machinist, of 14 years' experience, is open for engagement; good references. Address "Shop," AM. MACHINIST.

Wanted—Situation as supt. of engine and machine works. References covering 25 years' experience. Address Supt., AM. MACHINIST.

First-class machinist wants situation; accustomed to duplicate work; can handle men and contract job work. Address C. B., AM. MACHINIST.

Wanted—Situation as foreman of machine shop; many years' experience in building tools and machinery; good references. Address Practical, AM. MACHINIST.

A practical mechanic, with large experience in special machinery and management of help under the piece-work system, wants position as superintendent or foreman. Address F. J., Box 476, Ansonia, Conn.

Wanted—By practical mechanic, designer and draftsman, position as supt. or foreman of machine works; have had large experience handling men and systematizing work; best reference given; corresp'ce solicited. Address Box 486, Waterbury, Ct.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Engineering specialties; send for price-list. Crescent Mfg. Co., Cleveland, Ohio.

To make room for larger tool, will sell cheap, for cash, a planer 42"x42"x12', in good order. Address P. O. Box 2085, Bridgeport, Conn.

For Sale.—The process of Tinning, as applied to Tacks, carriage hardware, etc., Price low. Address "Tin" AMERICAN MACHINIST.

Light machinery of all kinds built at short notice. Good workmanship guaranteed. Pennington & Mills, 8 Dey st., Jersey City Heights, N. J.

Wanted—A good second-hand 60" lathe, to take 16' between centers. Address, with particulars, A. B. Bowman, 1101 N. 2d st., St. Louis, Mo.

For Sale—A Tabor engine indicator; used only three times; springs 20, 40, 60; all complete; will sell cheap. Address Box 109, Manistee, Mich.

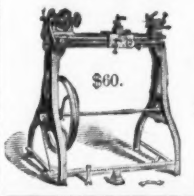
Roper's Care and Management of the Steam Boiler, $2 postpaid. Theo. Audel & Co., Booksellers, 32 Liberty st., N. Y.

Gun Machinery—For sale, a shop containing a full equipment of machine and special tools, patterns and patents required for making a well-introduced shot-gun. For particulars, address S. O Randall, 70 Weybosset st., Providence, R. I.

Wanted—A hydraulic press for putting on car wheels; a boiler-plate planer. Send full description and bottom prices to Geo. R. Lombard & Co., Foundry, Machine and Boiler Works, and Mill and Engine Supply House, Augusta, Ga.

Inventer and owner of new valve and valve-gear for high-grade automatic engine; also governor for single-valve automatic engine, and other valuable specialties; one having had a large experience in steam engineering, wishes to connect his interests with party who would manufacture, or might sell. Address E. V. C., No. 12 Lakeside Building, Chicago, Ill.

WATER WORKS MACHINERY
A SPECIALTY.
Cor'sp'd'ce Solicited. POND ENGINEERING CO. St. Louis, Mo.

CHANDLER & FARQUHAR,
177 & 179 Washington St.,
BOSTON, MASS.


TOOLS AND SUPPLIES
—FOR—
Machinists, Plumbers, Gas Fitters, Electricians, Model Makers, Roller Skate Makers, Amateurs, etc.
Send for Catalogue B.

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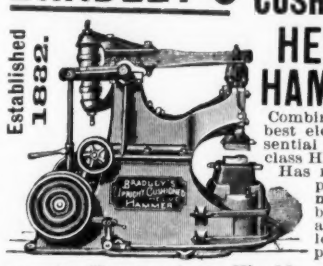

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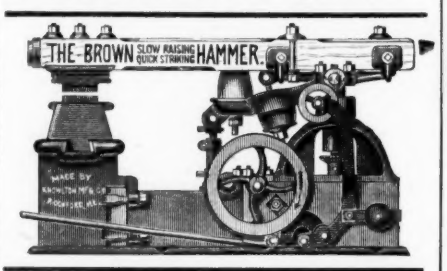

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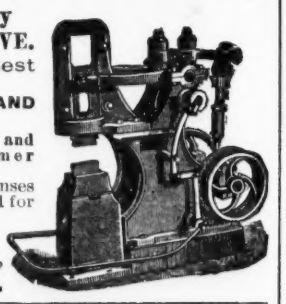
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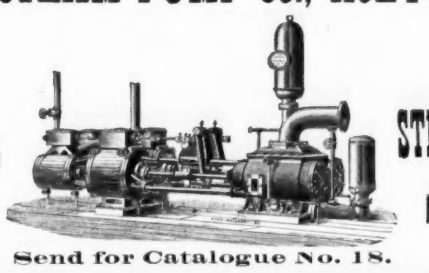
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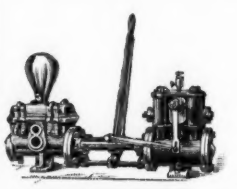
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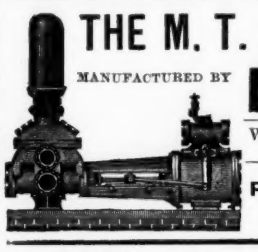
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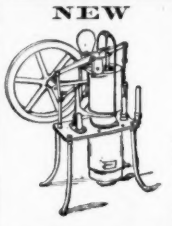
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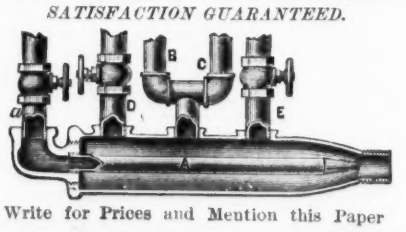

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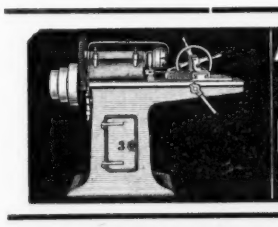

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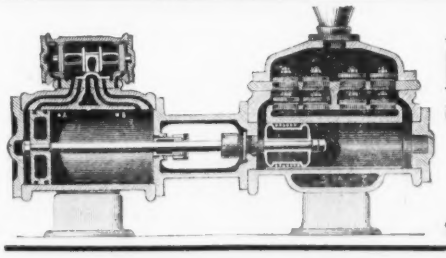

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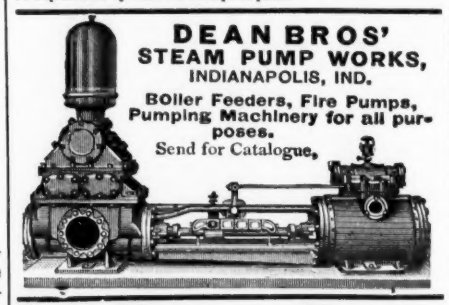

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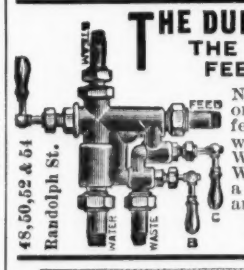

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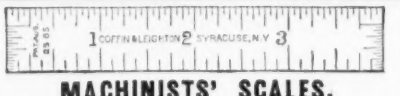

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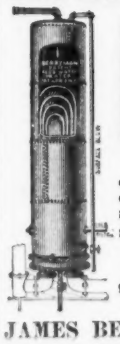

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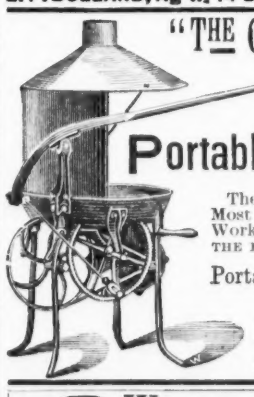

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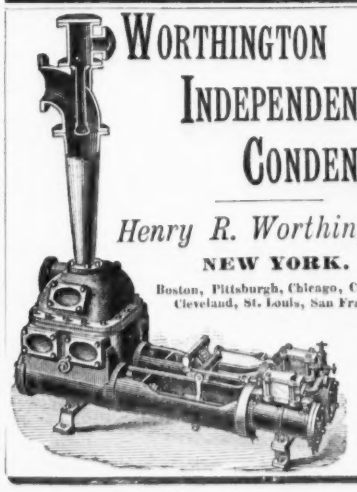

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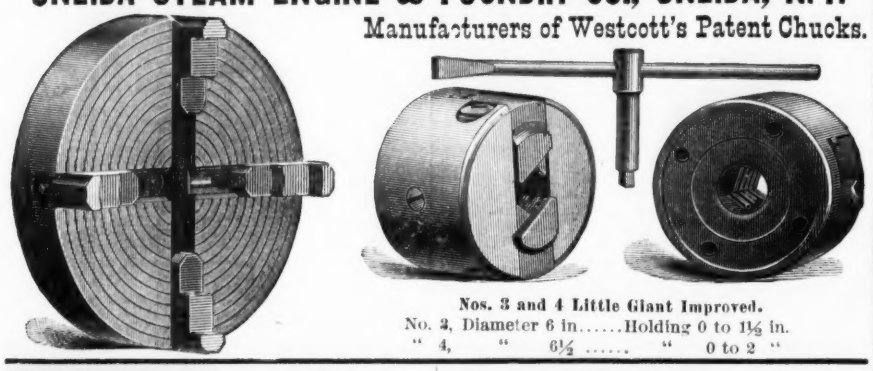

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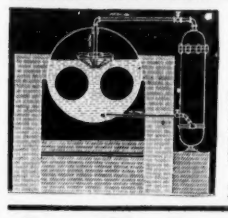

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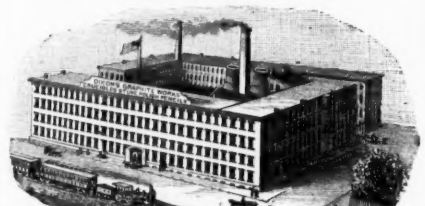

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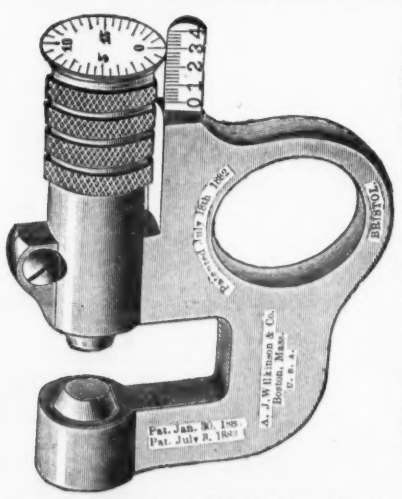

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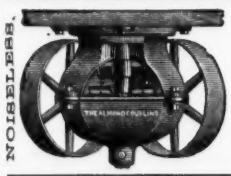

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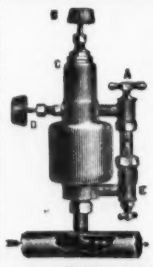

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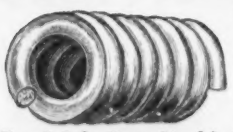

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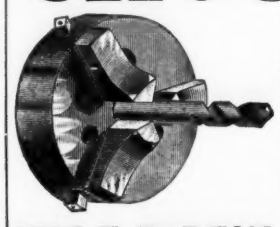

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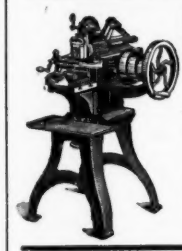

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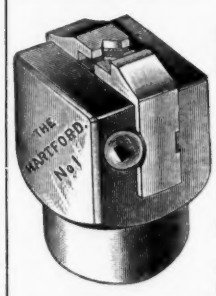

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Week before last we published, under this heading, references to a small portion of the practical articles that have been specially prepared for the AMERICAN MACHINIST, and have appeared in our columns during the last few months. Last week we published an additional list. We append another list below. No other mechanical journal in this country has or ever has had such a collection of practical articles, by writers of well known ability, as are presented in these columns week by week. Every issue gives information that is taken up and applied in the shops and factories in various parts of the country. Copies containing these articles can be readily obtained by ordering of any newsdealer, or by writing to this office, at 5 cents per copy.

J. C. Hoadley.
Unbalanced Bodies in Revolution. March 14, 1885
Diagram Showing the Inertia of the Reciprocating Parts of the Steam Engine. June 7, 1884
Inertia of the Reciprocating Parts of the Steam Engine. June 7, 1884; September 13, 1884

J. D. Campbell.
Fitting and Care of Axle Boxes. August 3, 1884
Draft Regulating Appliances. March 15, 29; April 12, 26, 1884
Fitting Locomotive Wedges. August 16 1884
Driving Boxes and Wedges. September 27, 1884
Building Locomotives in Repair Shops. February 9, 1884
Locomotive Draft Appliances. April 25, 1885.

Robert E. Masters.
Moulding Ammonia Boilers. November 15, 22, 1884
Cutting Down the Face of Gear Wheels in the Mould. October 25, 1884
Moulding Balance Wheels. August 2, 1884
Portable Cupola. December 13, 1884
Cupola Management. May 17, 1884
Melting in a Southern Foundry. April 12, 1884
Melting Small Quantities of Iron. June 14, 1884
Melting Steel in an Ordinary Cupola. August 23, 1884.
Casting Rolls with Shaft in Them. May 9, 1885.
Economy in Using Small Cupolas. May 16, 1885.
Steel Castings. Aug. 15, 1885.
Casting Steel in an Ordinary Cupola and Publishing the Process. July 25, 1885.

Jas. F. Hobart.
Selecting and Using Files. January 10, 1885
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Emery Grinding. January 24, 1885
Forge, Anvil and Lathe. February 28, 1885.
Grinding and Using Cutting Tools. April 18, 1885
Doing Jobs on Sunday. May 30, 1885
Examination of Stationary Engineers. August 22, 1885
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Angus Sinclair.
Chicago Limited Express. January 5, 1884
Fuel Economy with Locomotives. July 5, 1884
Locomotive Engine Running. February 9, 23; March 8, 22; April 5, 19; May 3, 17; June 7; August 16; November 1, 1884
Locomotive Economy. January 17, 1885
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Railroad Snow Plowing. January 19, 1884
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Efficiency of Brakes. January 10, 1885

Harris Tabor.
High Efficiency of Locomotives. February 14, 1885
Centrifugal Force in Revolving Bodies. April 4, 1885

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Laying Out Link Motion. May 10, 17, 24, 31, 1884
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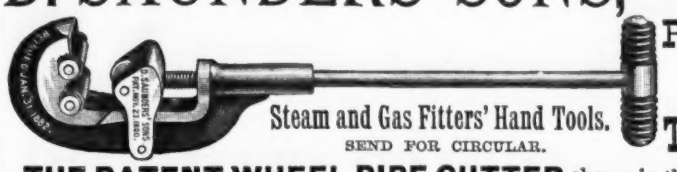

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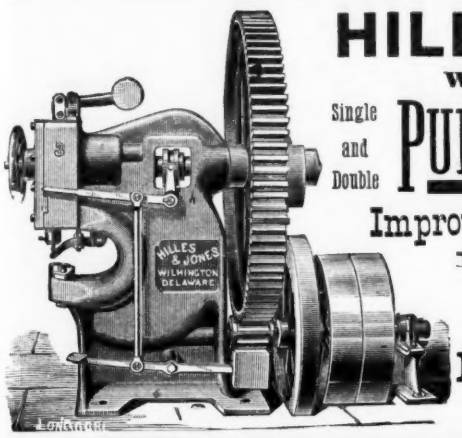

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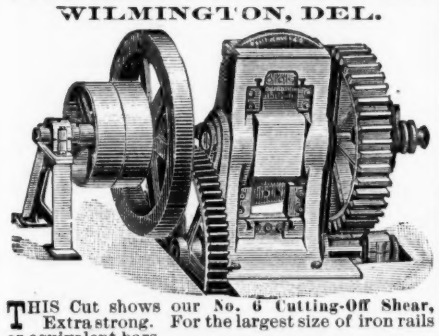

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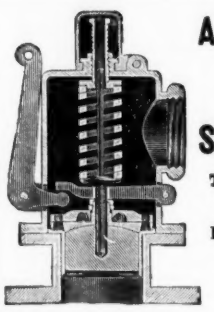

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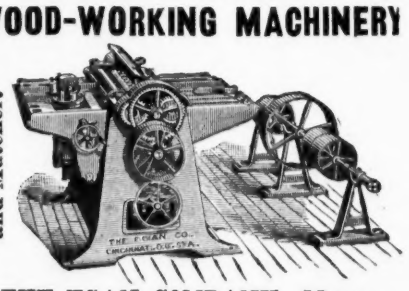

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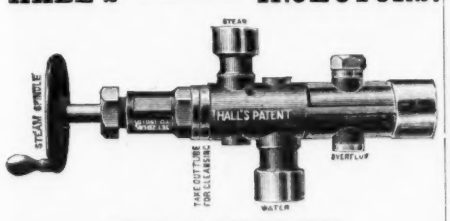

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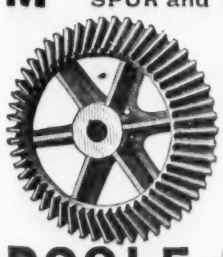

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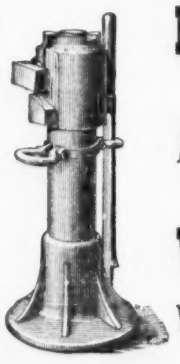

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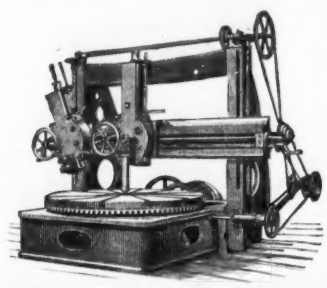

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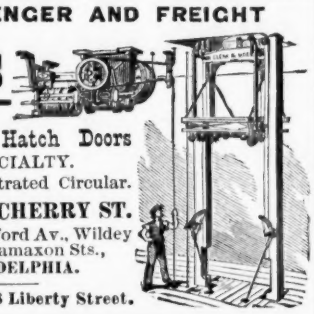

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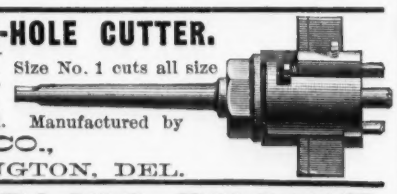

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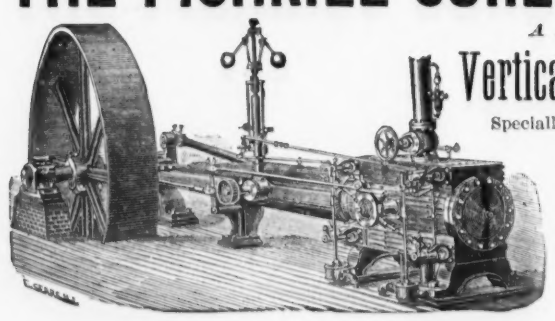

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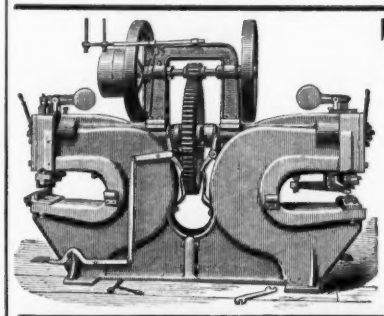

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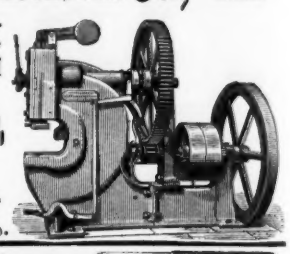

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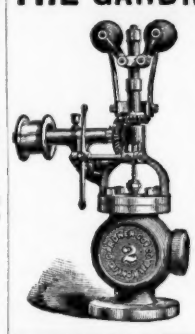

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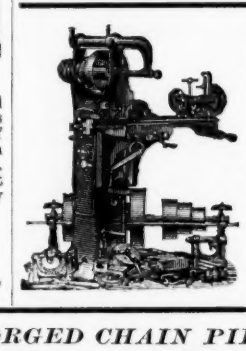

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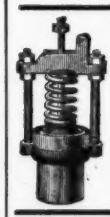

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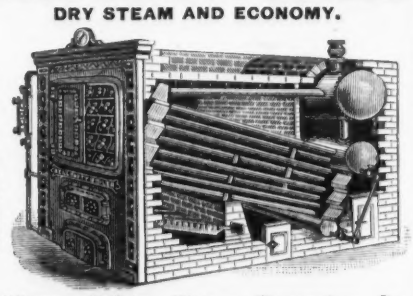

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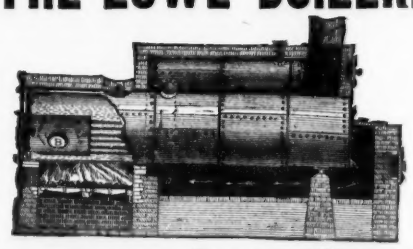

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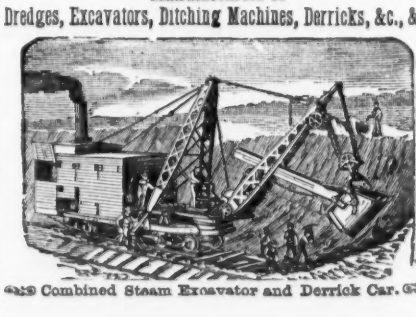

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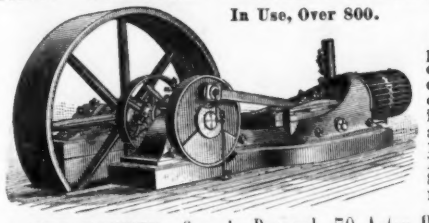

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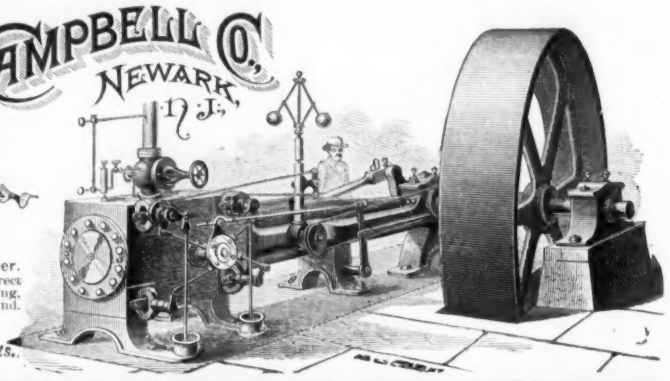

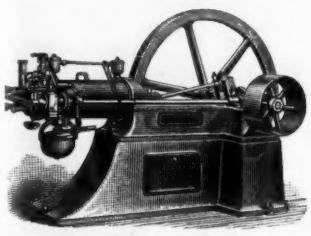

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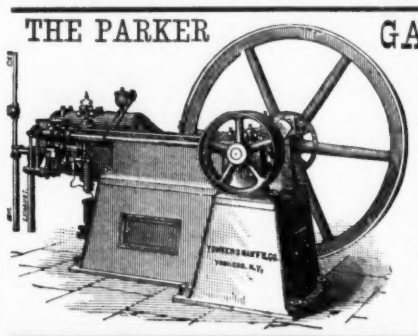

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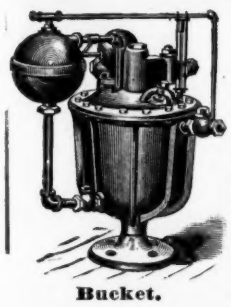

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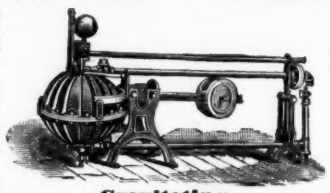

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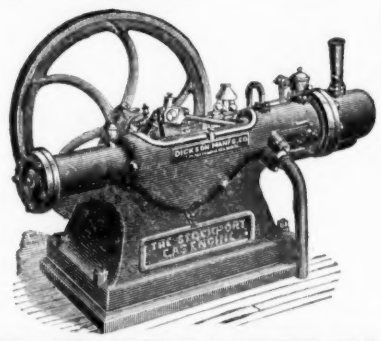

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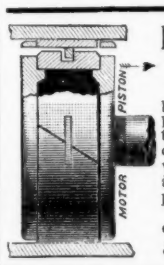

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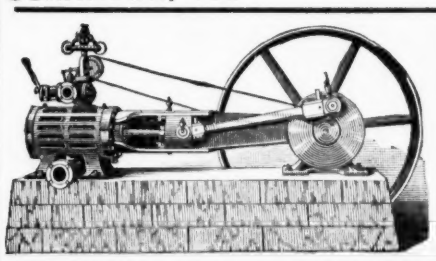

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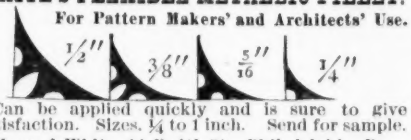

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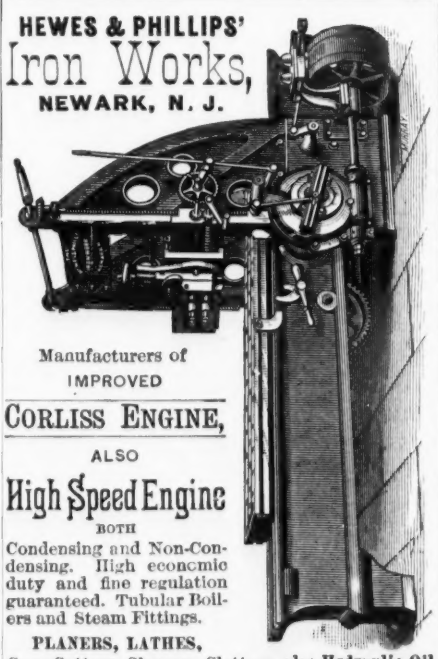

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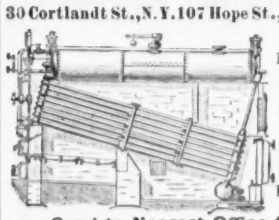

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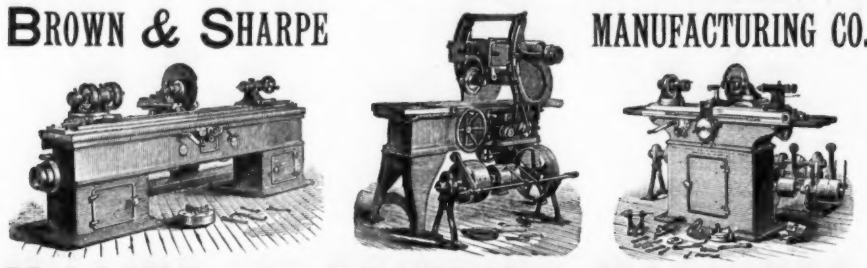

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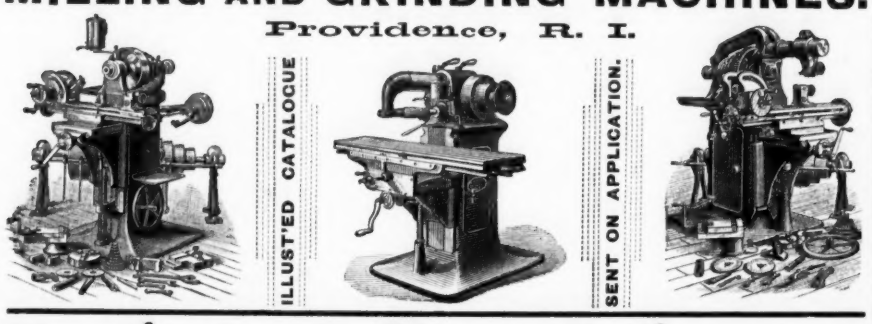

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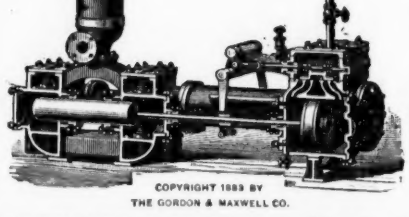

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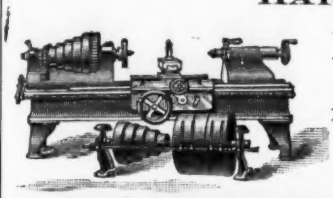

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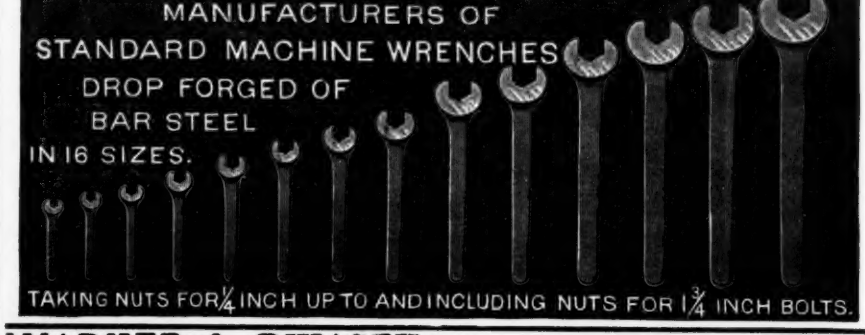

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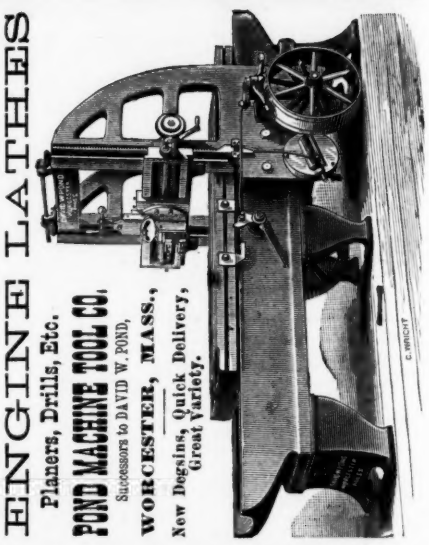

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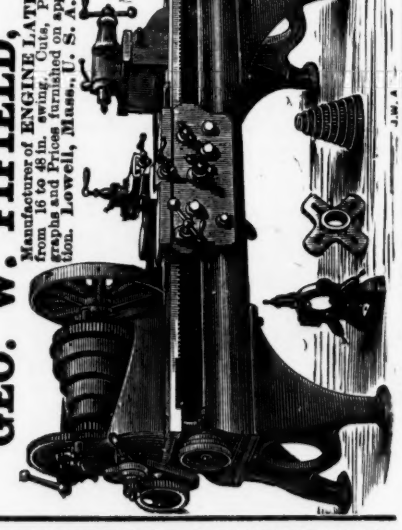

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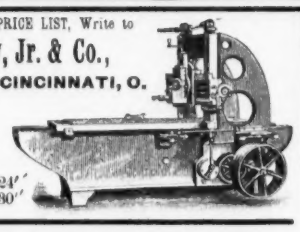

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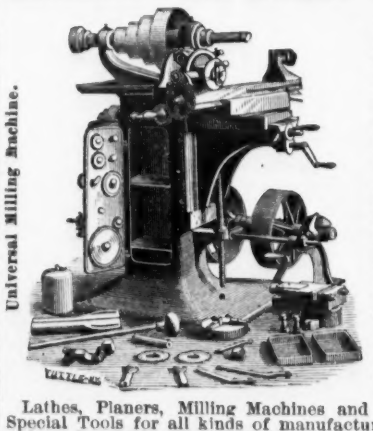

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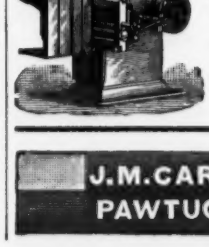

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